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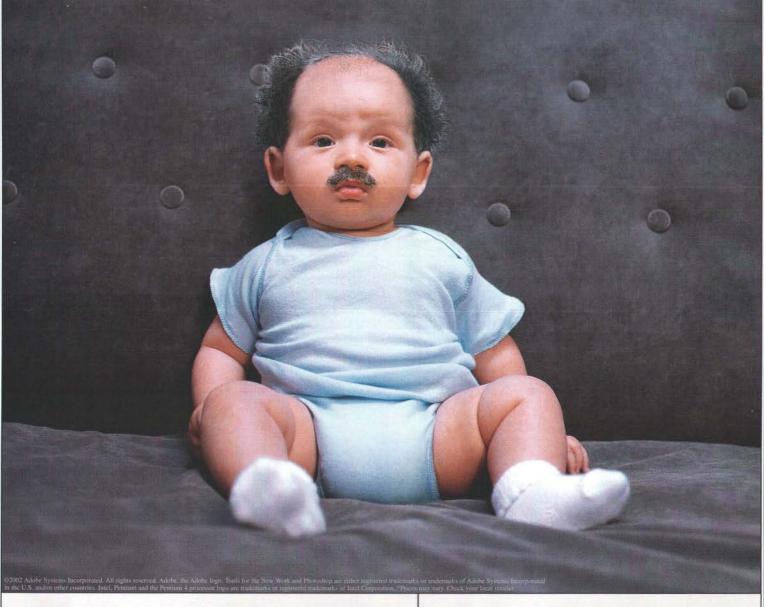
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FEATURES

Cover photograph: Jill Greenberg

CONTENTS

No-Kill Meat

WHOOSH

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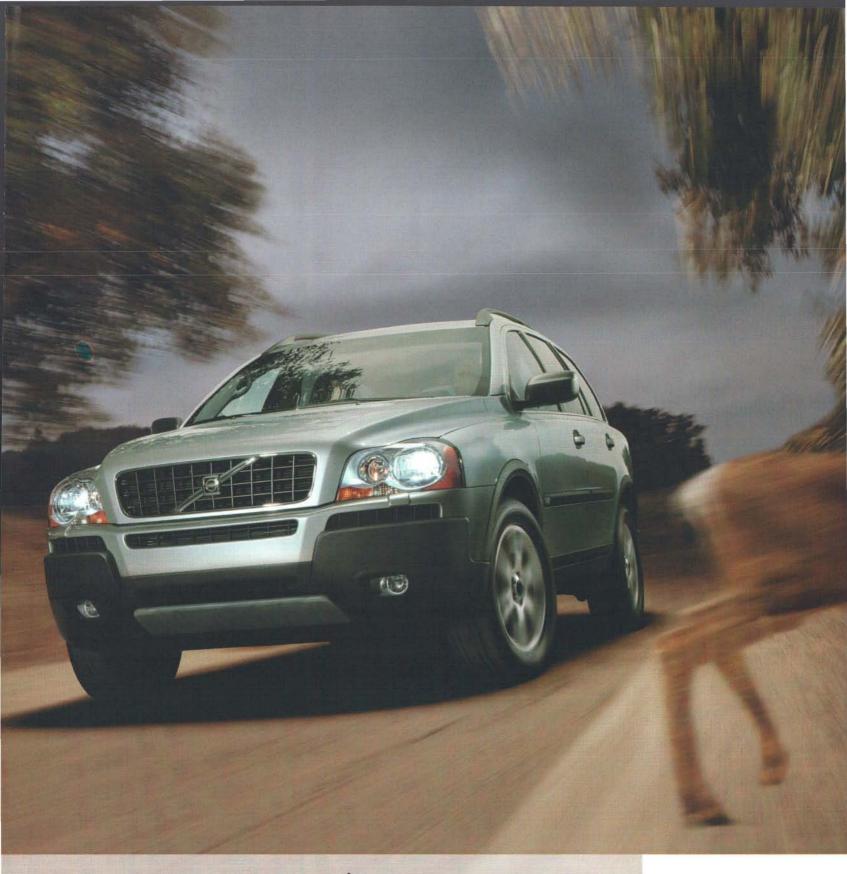
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THEN YOU BUILD.
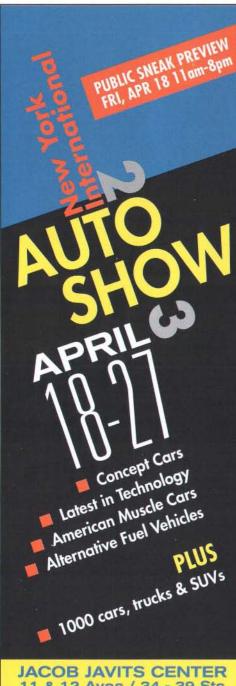
MOTOR TREND 2003 SPORT/UTILITY OF THE YEAR.

WIRED.

RANTS+RAVES

"Stopping Loose Covers," by Remo Cosentino.

Death-defying heroics were on your minds in March, an issue one gentle reader called simply "a good kick in the ass." While horse-power junkies bragged about their cubic inches of displacement, transplant fans had a bone to pick with "Stripped for Parts." A typical cutting remark: "Please continue to write stories on how much more desirable it is for organs to rot in the grave. Perhaps you could do a time-lapse photo study." Others chose stoicism over sarcasm: "When it's time to die, it's time to die." (To each his own — anyone wanna swap a dynamometer for a defibrillator?) Meanwhile, back in the slow lane: Acolytes of Dean Kamen credited the Segway with revolutionizing not only transportation but weight loss and charitable giving. One fast-thinking sales suggestion: "Dump the expensive batteries, put in a lightweight moped motor, sponsor a race on the X Games, and everyone will want one." Just keep that killer app off the sidewalk.

All That Drag

I have been involved with hot-rodding since the late '60s and have seen a stunning transformation in the past few years. "War of the Wheels" (*Wired* 11.03) leaves the impression of a struggle between factions, for and against computer tuning, but the only real conflict in car culture is between imports and domestics. The import crowd has front-wheel drive cars, mostly Hondas, and it's a lifestyle thing. Performance is only part of the deal. Let's face it, you're not gonna get retina-ripping performance from four-cylinder motors in front-wheel drive packages. Domestics are pre-'49 street rods, '60s-'70s muscle

"FOR HOT RODS, THESE ARE THE GOOD OL' DAYS."

cars, late-model EFI cars, and myriad drag classes.

There is a resurgence under way. Even those who don't understand electronic engine management are amazed by the possibilities and admit this emerging technology could unleash impressive performance. For hot-rodding, these are the good ol' days.
Charles Watson
Cheraw, South Carolina

As one of the old-timers Cole Coonce refers to in "War of the Wheels," I especially liked the article. Though I can't see the appeal of the new "laptop" cars, Coonce's approach and the way he writes made the article very enjoyable. I'm still not getting a Toyota or a nose ring, but I may get your magazine again.
Bob Frey
Waterford, New Jersey

Since "rice burners" is a derogatory reference, the term should be enclosed in quotation marks throughout the article (not just when it is first mentioned).
Shigeru Odani
Mamaroneck, New York

You have come loose from your moorings: I didn't subscribe to a hopped-up, high-testosterone men's magazine. Have you become mindless bots enslaved by the cycle of finding filler to put between the ads? Get a grip. Find your soul.
Chuck Jameson
Wilmette, Illinois

Along for the Ride

Regarding "Segway's Breakdown" (*Wired* 11.03): I thought big-name venture capitalists were supposed to help their companies with management advice and expertise. So how come John Doerr never explained "early adopters" to Dean Kamen? With any new product, there is only a small group of people willing to pay high prices for first-generation technology. The rest of us prefer to wait for improvements and price drops. Why did Kamen, or his backers, think the rules would be different this time around?

For now, I am sticking with a 25-pound, unlimited-range, sub-$1,000, two-wheeled transportation device that has benefited from more than 100 years of product development — my bicycle.
Stephen Turk
Los Angeles, California
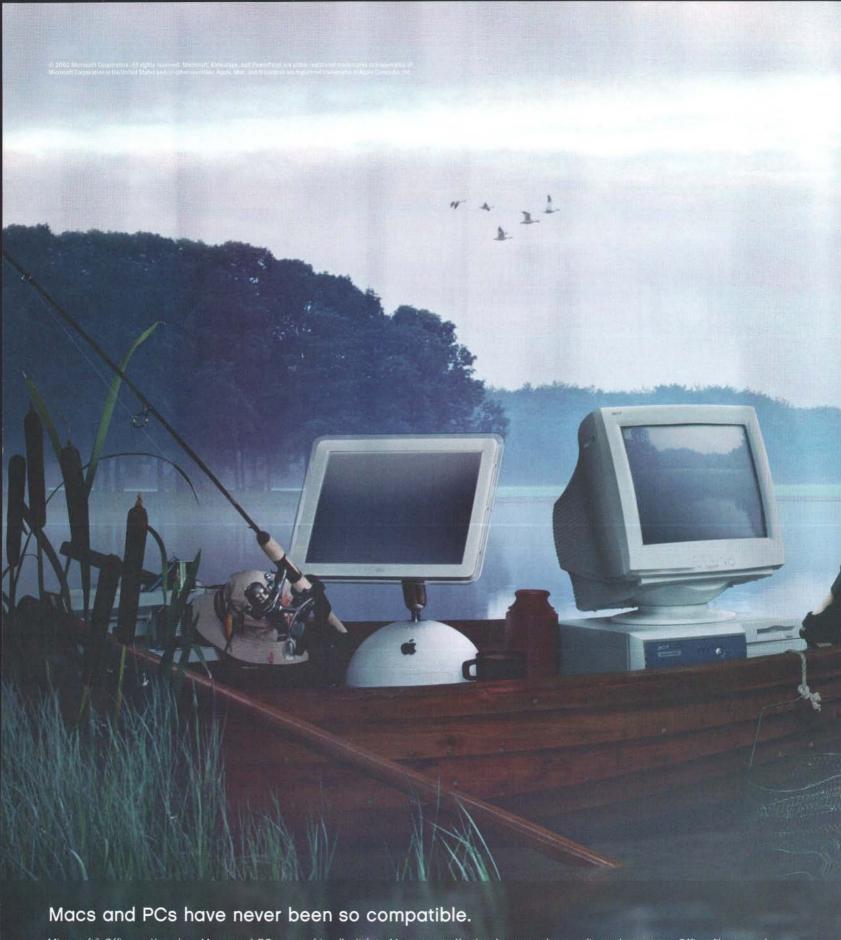
The Segway is working out great for a lot of people. A Google search yields many examples of real (i.e., nongovernment/business) people using Segways, myself included. I ride the transporter more than 7 miles per day in hilly Seattle. We've given up one of our cars, and we're now saving at least $600 per month (car payment, insurance, gas, parking). The article left out that there are regular folks using the Segway already, and there are many more who will receive them this month. You can read about my experiences at *www.bookofseg.com*.
Phillip M. Torrone
Seattle, Washington

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"ALL THAT REMAINS IS A COLD EMPTINESS AND A LIFELESS SHELL."

Inside the Chop Shop

I spent 10 years taking journalists into hospitals to observe transplants and the organ-donation process in Philadelphia. "Stripped for Parts" (*Wired* 11.03) is a perfect example of why it's necessary to screen those who are likely to be blown away by witnessing surgery and death. The sophomoric treatment of this subject in the article's text, headlines, and photos is a disgrace. Transplant success and survival rates are amazingly high, and organ transplantation is one of the true scientific, technological, and medical miracles of the past 30 years. I hope *Wired* readers are of the mindset that it's better to give life a second chance than to bury it in the ground.
Kevin T. Sparkman
Medford, New Jersey

I can't really say that I enjoyed reading your transplant article, but it certainly did strike a chord. As a surgical resident who trained in a major teaching hospital, I have been involved in more organ procurements than I care to remember.

Your piece does well in relating, with eerie accuracy, the surrealness of the experience, which has apparently not changed much in the past decade. But there are two other very important aspects of the tale that you haven't told. The first is the sometimes Herculean efforts of the critical care team as it tries to save the life of the brain-injured patient, and the irony of the Pyrrhic victory when the body, but not the brain, has survived. The other is the cold emptiness of the operating room at the conclusion

of the procedure, after the transplant team has rushed out with the living organs, after the anesthesiologist has turned off the monitors and ventilator, after the nurse and scrub tech leave. The room goes silent. All that remains is a lifeless shell, stripped of its organs, and one medical professional whose task it is to close the gaping wounds in the chest and abdomen. It is a sad, lonely, and depressing job, but an honorable one – a final and respectful thank-you to someone who has been able to give of themselves so that even in death, another might live.
Steven Bengelsdorf
Newton, Massachusetts

Prisoners put to death by lethal injection (or other means) should instead be made brain-dead and their organs used to help balance the ratio of available organs to needed ones.
Monty Abrams
Las Vegas, Nevada

To Boldly Go

Thank you for the great "Surviving 7G" (*Wired* 11.03). Given the subsequent tragedy of the *Columbia* space shuttle, your article resonated even more. Our men and women explorers do what pioneers always do: They put themselves at risk in the pursuit of knowledge and in search of new frontiers. (And sometimes they get to do some really cool things.)
Albert E. Wood
Averill Park, New York

Please Fasten Your Virtual Seat Belts

It's hard to believe that there are 45,000 aero-geeks pushing virtual tin for pleasure ("Always a Dull Moment," *Wired* 11.03). Perhaps they should form an alliance with *EverQuest* and There.com to virtually transport the virtual people in Greater Faydark on a virtual vacation. Now, if they charged real dollars, that would be a business model. Hmm ... are you listening, United?
Jonas Lamis
Austin, Texas

That Sinking Feeling

Graham Hawkes asserts that NASA should shift its focus from the stars to the depths (View, *Wired* 11.03). If our current record and Hawkes' ideas are any indication, an in-depth (pardon the pun) exploration of the ocean by the US government would be disastrous. This culture's exploration turns too easily into exploitation. It's one thing for the scientific community to explore the deep for the sake of science, but once we begin to mine the floor for resources, or to collect species for use in the biotech industry, we have started down a slippery slope. We have already seen the effects that human interference has wrought on the terrestrial environments – I wonder if we should be so hasty as to bring this interference to the oceans.
Dave Musgraves
Claremont, California

UNDO
➡ Back-Assward: Nissan's ZX and Toyota's Supra are rear-wheel drive ("War of the Wheels," *Wired* 11.03).
➡ Ultrawideband of Brothers: Localizers transmit data at 10 Kbps, considerably slower than Wi-Fi (B.F.D., *Wired* 11.04).

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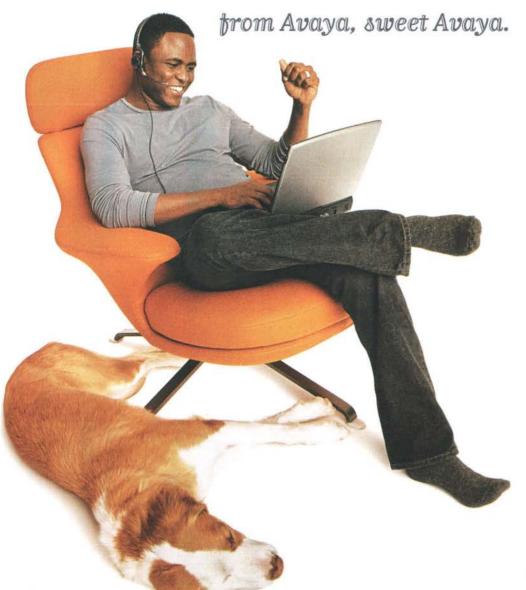
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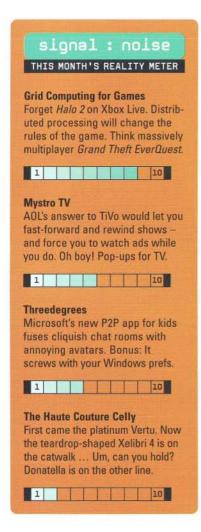
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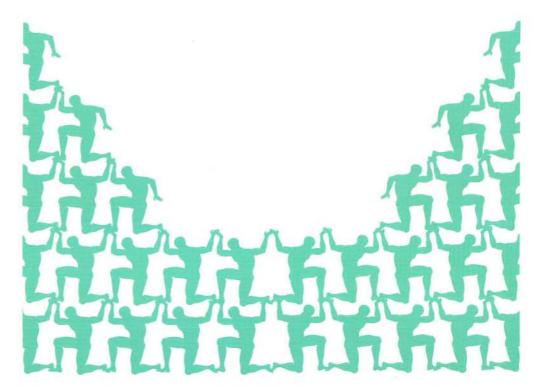
from Avaya, sweet Avaya.

The Shape of Things to Come
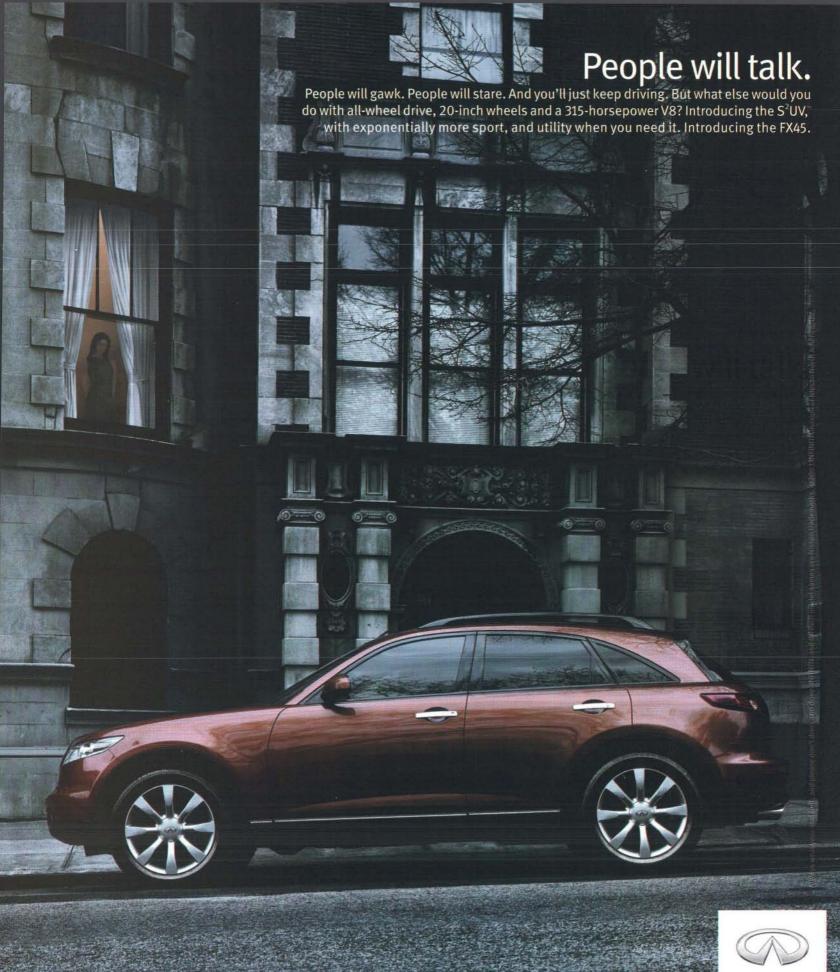
The bell curve, that beautiful form of regularity, is getting turned upside down. by Daniel H. Pink

AS THE MARGINS RISE, THE MIDDLE COLLAPSES

In the mid-19th century, a few of Europe's finest scientists and mathematicians noticed something peculiar about the way the world organized itself. When they measured large samples of various things – the length of people's middle fingers, say, or the price of certain goods over time – the results tended to cluster around an average. When plotted on a chart, the data took the shape of a bell. This bell curve, as it was dubbed, defined "normal distribution" – and it became a fundamental law of natural science, an elementary truth about the nature of reality. Charles Darwin's cousin Francis Galton – who pioneered the related idea that everything from stock prices to your descendants' IQs would eventually revert to the mean – called the bell curve "an unsuspected and most beautiful form of regularity."

But today Galton's beautiful form might not be so regular. Although bell curve distribution is still considered normal, a surprising number of economic and social phenomena now seem to follow a different arc. Instead of being high in the center and low on the sides, this new distribution is low in the center and high on the sides. Call it the well curve.

It's popping up everywhere. Take the size of organizations. Large companies – pairing off like beer-goggled students at a frat party – are becoming gargantuan enterprises. Think HP-Compaq, Citigroup, and AOL Time Warner. Meantime, small enterprises are also proliferating. The US Census Bureau reports record numbers of "nonemployer businesses" – teensy firms without any paid employees. Yet while the big grow bigger and the small multiply, ➡

EMEK

and they don't know how to react so they stare or whisper or peek out living room curtains because anything or anyone with such confidence and flair and blatant unapologetic disregard for trying to conform to tradition and convention makes them wonder if maybe they're witnessing some kind of revolution or evolution or

← midsize enterprises are waning. The pattern is similar in geopolitics. The past decade saw the rise of both huge multinational federations (Nafta, the European Union) *and* tiny secessionist movements and small independent states. But the political entities in the middle – countries such as Italy and Spain, for example – are on the unprecedented brink of losing population.

Consumer culture is going bimodal, too. Electronics manufacturers are racing to equip us with screens small enough for cell phones or large enough for home theaters – relegating standard screens to the scrap heap. High-end luxury hotels and low-end budget chains are doing well – but at the expense of mid-price accommodations. In retail, Wal-Mart is soaring, boutiques are thriving, but middle-brow Sears is struggling. As *The Wall Street Journal* noted last year, "consumers are flocking to the most expensive products and the cheapest products, fleeing the middle ground in between."

Then there's the drooping middle class. The Federal Reserve Board's latest analysis of family finances showed that from 1998 to 2001, American incomes were up across the board. But when economists divided the population into five equal segments, a well curve emerged. "Incomes grew at different rates in

different parts of the income distribution," the Fed reported, "with faster growth at the top and bottom ranges than in the middle."

We can even glimpse this inversion in the classroom, where most of us first encountered the bell curve. The National Assessment of Education Progress is a standardized test also known as the nation's report card. It measures how well American schoolkids can read and
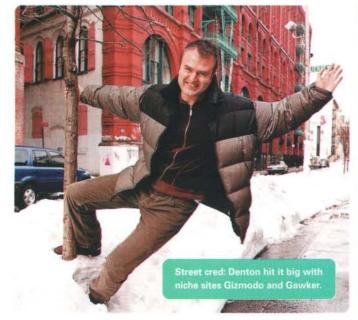
closely, we find ourselves staring down a distributional well. The implications are huge: insurers, marketers, and policy-makers may be basing decisions on faulty premises about what is normal. They're assuming a vibrant center – Middle America, middlebrow tastes – when the action has migrated to the edges. The 180 from bell curve to well curve has turned their logic on its head.

THE WELL CURVE DESCRIBES
INCOMES, NATIONS, EVEN KIDS

groups them into four categories: advanced, proficient, basic, and below basic. From 1992 to 2000, the percentage of students scoring in the top two categories increased. The percentage scoring at the bottom level remained distressingly high. But the portion scoring basic dropped nearly 10 percent. Even the nation's children, it seems, are graded on a well curve.

Of course, not everything we can measure conforms to this new shape. In national politics, the fastest-growing affiliation is Independent. Diversity and interracial marriage are rendering the old bimodal and trimodal racial categories irrelevant. Yet almost everywhere we look

Galton and his contemporaries believed that conditions would deviate from the bell curve only during periods of transition. Every age, of course, supposes it is living through a unique era of profound change. But in our case, the conceit might actually prove true. The madness of our times might simply reflect our stumbling effort to revert to the mean. Either that or one of the world's eternal verities is less eternal than we supposed. This deviation may turn out to be anything but standard.
Daniel H. Pink (dp@danpink.com), *the author of* Free Agent Nation, *is writing a book about the rise of right-brain thinking in modern life.*

Street cred: Denton hit it big with niche sites Gizmodo and Gawker.

"IT'S A LOT LIKE FUNDING INDIE MOVIES"

Nick Denton, Blog Mogul
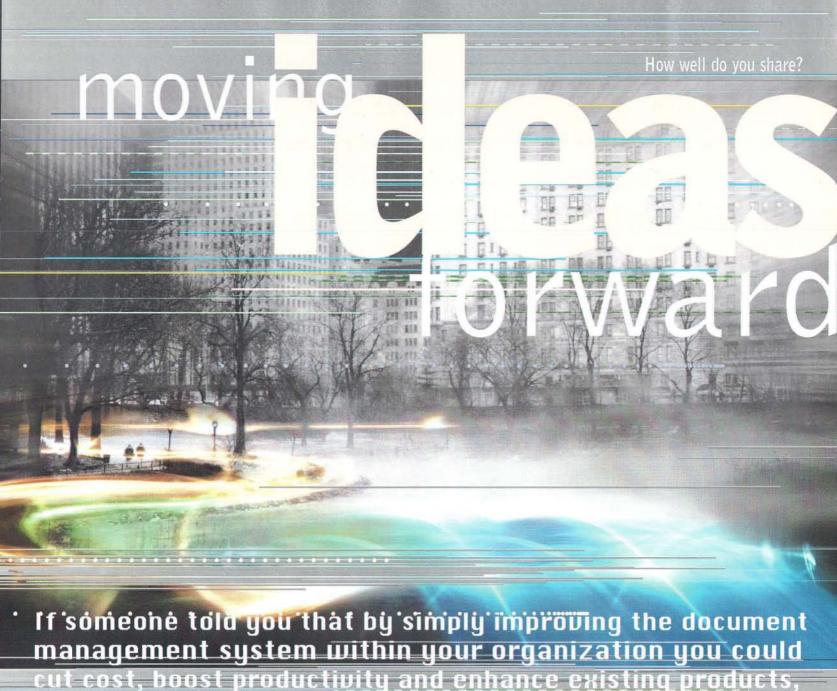
The most extraordinary thing about Nick Denton's nanopublishing model is how ordinary it is. Step 1: Come up with an idea for a weblog. Step 2: Find a designer to create the template. Step 3: Pay an editor a couple thousand bucks a month to write it. Step 4: Pocket a small profit from affiliate sales and banner ads. Step 5: Repeat Steps 1 through 4 a few dozen times.

Denton, the 36-year-old former CEO of Moreover.com (a news search site) and cofounder of First Tuesday (a London-based networking forum for venture capitalists), recently launched two commercial weblogs. Gizmodo is a guide for gadget freaks, and Gawker is a smart-alecky gossip and lifestyle sheet about New York City. His model makes sense because it keeps costs ridiculously low compared with similar Web operations. For less than $40,000, Denton can afford to put up a site that may not pan out. "It's a lot like funding indie movies," he says. "Out of five, two might close down, two might be moderate successes, and you'll have one breakout."

Denton doesn't advertise or market his blogs. "Weblogs are the most meritocratic form of media the world has ever seen," he says. "If they're terrific, they can have pretty dramatic growth rates." To wit: Gizmodo jumped from 38,000 pageviews last August to 232,000 in January, and it's already making a little money. Launch 20 or 30 such sites, and you start to have some real income.

Denton's moving in that direction. This year, he wants to bring out three more sites, including a travel blog, a consumer guide for frugal millionaires, and what he describes as a "high-class erotica site linking to the best porn on the Web."

Even though his business model is bare bones, Denton is convinced nanopublishing could make niche media profitable online. It could even save foundering sites like *Salon*. His advice: "They should do a restart" – and go nano.
– Mark Frauenfelder

The average FORTUNE 1000 company spends an astounding 8% of revenues on document management. In some industries, it's as high as 25%. Productivity? Up to 60% of white-collar time is spent managing or mis-managing documents. Inefficient document management results in a slower moving business. Not to mention less profitable. The solution to this dilemma? That's what Ricoh document management is all about. Our fully compatible, networked Multi-Function Printers, Copiers, Scanners, Fax and e-mail based Software Solutions can help your organization share ideas more efficiently, which moves them forward faster and accelerates productivity. Which leaves only one key question.

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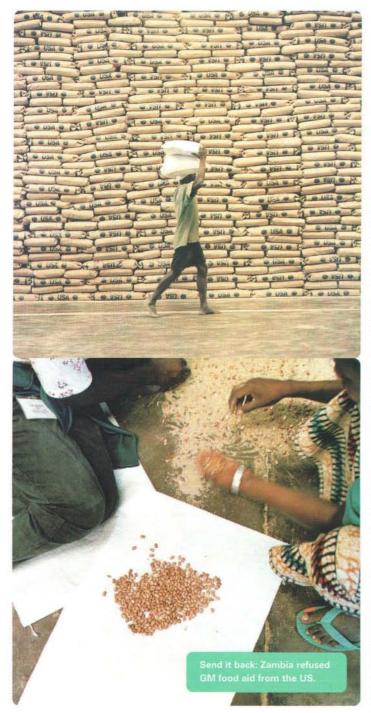
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Why GM Food Could Start a Trade War

Nearly a third of Zambians were starving last year when the United States donated 74,600 tons of food to the southern African nation. President Levy Mwanawasa didn't want it. The food – mostly corn – was genetically modified to be pest-resistant. To Mwanawasa, that made it "poison." Never mind that numerous scientific bodies have deemed it safe. If he were to accept it, he'd jeopardize future crop exports to GM-wary Europe – and imperil his nation's economy. Zambia is the most dramatic example of the growing conflict over GM food – one that threatens to ignite a global trade war. Here's a guide to the competing interests in a scuffle that makes cloning debates seem tame. **– David Appell**

Americans buy it

Introduced in the mid-'90s as a way to decrease pesticide use, GM crops now dominate US agriculture. Today, 70 percent of all American foodstuffs contain ingredients with altered DNA. Acreage grew from zero in 1996 to about 88 million in 2002. For the most part, US consumers seem more concerned with the fat in their diets than genetic engineering. Not so in Europe. The EU placed a moratorium on GM foods in 1998 and has used its economic leverage with African governments to get them to do the same.

Europeans fear it

Europeans cling to the time-honored idea of food purity, preferring fresh to processed, stovetop to microwave. Despite assurances that GM food is safe, consumers remain dubious; they haven't forgiven farming authorities since being misled about the spread of mad cow disease. The European Commission is trying to lift the moratorium, replacing it with legislation requiring that any food containing more than 0.9 percent modified ingredients be labeled. But given the way consumers feel about GM, such a change probably wouldn't make much difference.

Environmentalists hate it

Greenpeace and Friends of the Earth have come down hard on GM crops – especially in Europe, where they have more lobbying power. They argue that we won't know for decades the danger GM food poses to our health, and they're particularly concerned about the environment. They worry GM crops will overtake indigenous strains, kill species of feeding insects, and create superweeds. The groups also object to the influence that Big Ag companies like Dow and Monsanto have over American farmers – not to mention the cozy relationships between these corporations and US regulatory agencies.

Farmers are locked into it

GM seeds increase crop yields, save money on expensive pesticides, and reduce the need for fertilizer. But the EU's moratorium has cost US farmers $300 million in corn exports. With so much at stake, why don't farmers switch back? It's too expensive. And they can't grow both GM and standard crops – there's no accounting for airborne pollen.

Biotech execs are banking on it

Meanwhile, science marches on. Public biotech firms spend $15 billion a year on R&D and are about to release a new generation of products that contain everything from new genes to drugs and industrial chemicals. Epicyte Pharmaceuticals expects to begin clinical trials next year on a herpes antibody derived from corn. Which means the heated GM debate will only get hotter.
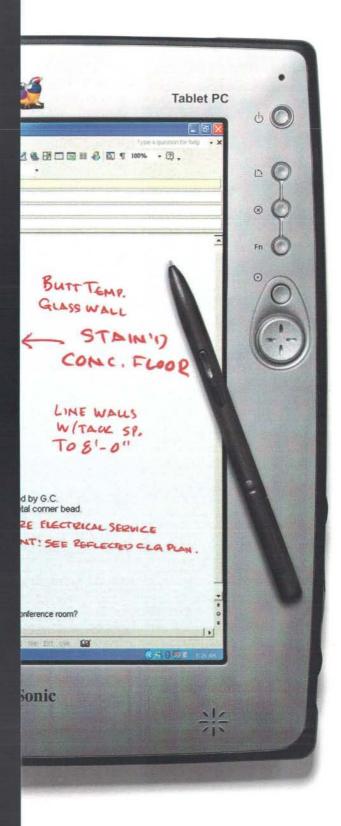
Send it back: Zambia refused GM food aid from the US.

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MARC SHOUL

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The FBI's Candyman Cases Go Sour

The child-porn dragnet known as Operation Candyman – touted as one of the FBI's success stories last year – got rolling when the Feds raided more than 700 homes in the US. The justification for the bureau's search warrants? An agent's affidavit swearing that all members of a free Yahoo! group had opted to receive illegal images via email.

In fact, most of the targeted members had opted out, leaving the FBI with little more probable cause for search than an email address, which anyone on the Net could have entered ("The United States of America v. Adam Vaughn," *Wired* 10.10). In March, two federal judges tossed out evidence in Candyman cases with sharp rebukes for the FBI's "reckless disregard for the truth" and assault on privacy. St. Louis District Judge Catherine Perry ruled the government's position is the equivalent of saying that if someone subscribes to a drug legalization newsletter, "there is probable cause to believe that person possesses drugs."

While the judges' statements cast light into a shadowy area of law enforcement, they may not help the scores of defendants – like Adam Vaughn – who pled guilty and signed away their right to appeal for a promise of a lighter sentence.
– **Steve Silberman**

Oh, Nooo! What If GPS Fails?

John Petersen doesn't like surprises, but he studies them for a living. The director of the Arlington Institute, a scenario-planning outfit in Virginia, helps the government think about the unthinkable. His latest inquiry: What if the US Global Positioning System stopped working?

It's not as far-fetched as it might sound. Eighteen of the 28 satellites in the GPS constellation are operating past their intended lifespan or suffering from equipment failure. There have been three launch incidents in the past five years, and the Air Force, which maintains the 20-year-old network, is overburdened with competing space priorities.

Given the circumstances, planners are concerned with the system's health. "If GPS were to fail completely, the cost would be incalculable," Petersen says. "Civil aviation, trucking, shipping, and telecommunications would be worst hit, but countless other industries would be affected." Internet activity would slow to a crawl, because many backbone operators rely on precise GPS time stamps to route data. Agribusiness and commercial fishing could be blinded, causing food prices to skyrocket. The $12 billion market for GPS devices would be sent reeling, and the arrival of location-based wireless services would be set back years.

Pentagon officials insist the situation isn't all that dire. GPS can withstand the loss of several satellites before becoming completely dysfunctional, says Owen Wormser, who oversees space communications issues from his post in the Office of the Assistant Secretary of Defense. "If it ever came to it, the system would degrade slightly, rather than seize up," he says. Indeed, the Air Force has 13 replacement satellites in the pipeline (though at this point it doesn't have the Delta rockets on hand to send them into orbit). The Air Force did launch a new satellite in February, hurrying it into service in half the usual time.

Wormser looks forward to the day when the next generation of GPS technology is put into place – and paid for by the private sector, which accounts for 90 percent of the system's usage. "With so many vested commercial interests, why shouldn't industry chip in?" Wormser asks. He's pushing a subscription-based model in which the military would provide commercial GPS services. The system would be administered by a civilian agency, which would coordinate with industry.

Before that can happen, though, the long-awaited GPS III must get off the ground. Its satellites will feature stronger, jam-proof signals, more precision, and greater reliability. But federal budget cutbacks have postponed the first launch of this constellation until 2012. Meanwhile, the European Union is drafting plans for its own system, Galileo, which would provide similar commercial services by 2008. Wormser doubts the Europeans, who've missed past deadlines, can deliver by then. Still, he says, "the longer we continue to support the current system, the worse we'll be in the long run." Maybe a little failure wouldn't be such a bad thing after all.
– **Andrew Zolli**

April 2003

ÜBER AUTO

Der Neu Lexus RX 330.
Fasstensietbeltz! p.31

ÜA
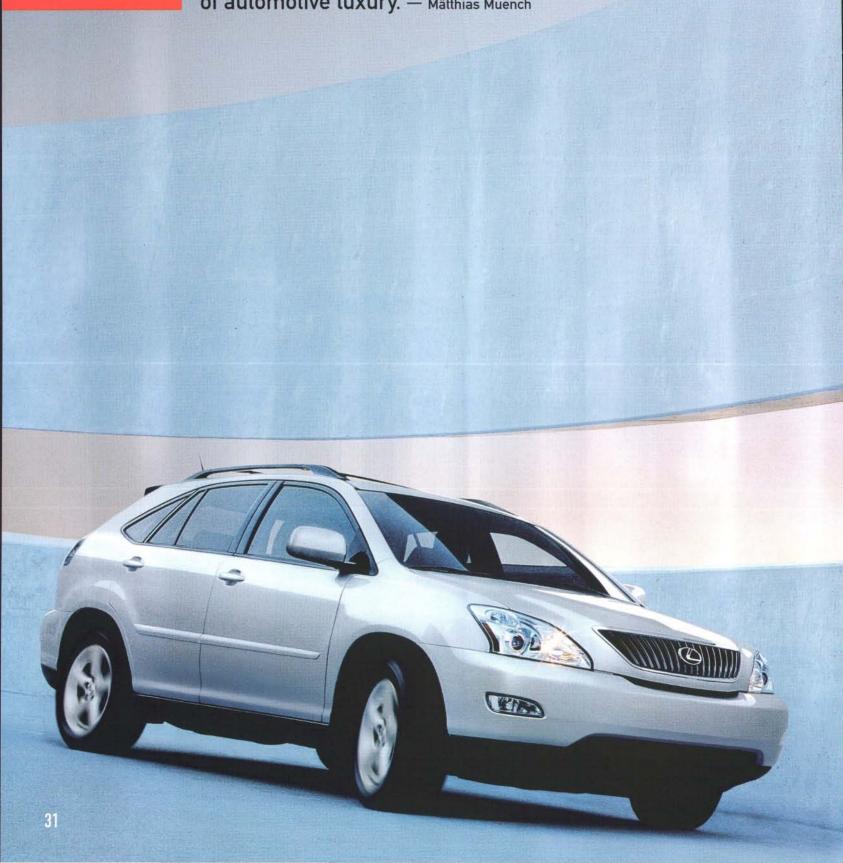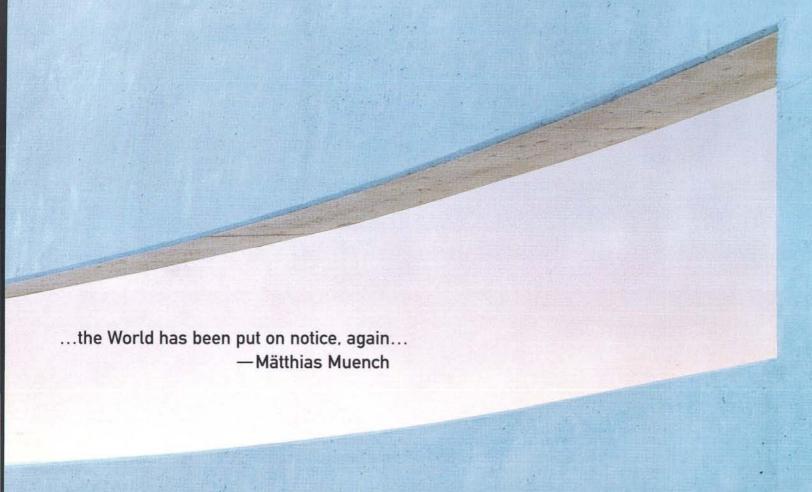
Willkommen Zu Der Wunderbar Wagen.

Stuttgart nach Munich in der neu Lexus RX 330: 218 kilometers that will forever change the world of automotive luxury. — Mätthias Muench

Achtung Deutschland. As a German automotive journalist,* I have always taken our leadership for granted—but not anymore. When I first laid eyes on the new Lexus RX330, I immediately realized that the world has been put on notice, again. My journey began in Stuttgart. One word describes the acceleration of the 230-horsepower, 3.3-liter, VVT-i engine: schnell. Once on the Autobahn, I easily reached 180 kph. In fact, I had to remind myself that this was not a Sportwagen, but an SUV, because at speed the suspension lowers to enhance aerodynamics and ride.† As I drove past the best of what Deutschland has to offer, the symbolism was difficult to ignore. We in Germany have been overtaken by the only vehicle in its class with a rearview camera† and Dynamic Laser Cruise Control,† not to mention the Adaptive Front Lighting System† that turns around curves. As I arrived at the outskirts of Munich, I finally understood what they mean by, "The passionate pursuit of perfection."

...the World has been put on notice, again...
—Mätthias Muench

THE NEU LEXUS RX. THE FACTS.

What can you say about a technologically luxurious vehicle that features a Rearview Camera,* Dynamic Laser Cruise Control* and headlights that turn around corners to illuminate the road ahead?* Well, there is the Power Rear Door,* Air Suspension,* 11-speaker Mark Levinson® Premium Audio System,* DVD Rear-Seat Entertainment,* Class-Leading Fuel Economy,† and everything that makes a Lexus a Lexus. Wunderbar.

TECHNISCHE SPECIFIKATION:

0–60 Acceleration	7.7 seconds (FWD)‡
Horsepower	230 HP @ 5,600 RPM
Torque	242 lb-ft @ 3,600 RPM
MPG	20 city/26 highway (FWD)†
Drag Coefficient	0.35
Turning Circle	37.4 ft

Open Source Spuds

Biochemists in India have come up with a first in genetically modified organisms: patent-free seeds. The transgenic crop produces potatoes packed with 30 percent more protein (thus its name, the "protato") and increased amounts of amino acids. If all goes well in final health tests, Indian farmers will harvest protatoes by year's end, and the government will distribute them as a cheap and easy source of nutrients. The scientists, including Subhra Chakraborty (above), work at Jawaharlal Nehru University in New Delhi. They hope the seeds will start a bioengineering trend of researchers suspending their intellectual property rights to share findings with peers and make progress more quickly. – **Eric Steuer**

jargon watch

CSI Effect
The impossibly high expectations jurors have for DNA and other crime scene evidence after watching a few episodes of *CSI*.

Generation O
Slang term for today's swelling population of dangerously obese children.

Chimping
Pro sports photographers' habit of flipping over their digicams to preview shots and to periodically *ooh-ooh-ooh* over the good ones.

Hide-and-Sleep Weapons
"Weapons that can loiter over a battlefield or sneak into enemy territory and 'sleep' until an appropriate military target blunders into their sights," according to *The Straits Times* of Singapore. Example: Lockheed Martin's Loitering Attack Missile, which seeks out mobile artillery.

Missing Mars
Screwing up an engineering project by failing to specify whether the metric or English measurement system is being used. Refers to the Mars Climate Orbiter, which was lost when two teams used different systems to build key components.

– **Gareth Branwyn**
(jargon@wiredmag.com)

Thanks to contributors Cormac Eubanks, Marty Katz, Barry Popik

DRUGS

Getting High for Science

Ecstasy isn't just for fun anymore. This rave fave is one of several illegal substances now being tested for legit medicinal purposes. A research explosion in neuroscience has led the FDA to loosen its grip on MDMA and other recreational drugs. So, even as the Feds spend $20 billion a year on the drug war, scientists in the US and abroad have begun studying the potential benefits of X, marijuana, and psychedelic mushrooms. Here's a look at the whys behind the highs. – **Steven Kotler**

Ecstasy
The DEA doesn't like it, but South Carolina psychiatrist Michael Mithoefer got FDA approval for the first double-blind study on the effect of MDMA on people suffering from post-traumatic stress disorder. Victims of violent crimes will get ecstasy combined with heavy therapy. The DEA has also touted research suggesting that MDMA *causes* Parkinson's disease, but a recent study out of the University of Manchester showed that the drug *reduces* tremors.

Psychedelic mushrooms
For years, anecdotal reports pointed to the salutary effects of psilocybin on people with obsessive-compulsive disorder. Now Francisco Moreno, a psychiatrist at the University of Arizona at Tucson, is conducting the first FDA-approved psilocybin study in more than 25 years. Moreno hopes to replicate the anecdotes in the lab. Also, the FDA recently green-lighted a UCLA study of the effects of psilocybin on chronic anxiety and depression in end-stage cancer patients.

Marijuana
Researchers at UC San Francisco recently finished a first-of-its-kind study on the safety of marijuana use among HIV-positive subjects. No ill effects were found. Now they're ready to test whether weed combats multiple sclerosis as well as the wasting syndrome that afflicts AIDS patients. Meanwhile, UC San Diego doctors will evaluate how effective marijuana is in alleviating the suffering of late-stage cancer patients.

TELECOM

3 Ways to Rethink the Pay Phone

The mobile phone was supposed to be the death knell of the humble pay phone. Although a third of the nation's 2.4 million coin-ops have been scrapped, a few die-hard companies are finding ways to give them new life.
1. Wi-Fi hot spots. Bell Canada is embracing the wireless age by turning hardwired pay phones into Wi-Fi hot spots. Itinerant laptop users will be able to log on whenever they wander in range of a booth. But who wants to surf the Web from a gas station?
2. Web portals. British Telecom is converting pay phones into Internet kiosks that allow you to send email and text messages, browse online, and make phone calls. It's like having all the features of a cell phone conveniently bolted inside a giant, immobile box!
3. Video postcards. Video-Tel of Dallas and Toronto has installed 29 webcam-enabled phones from Niagara Falls to Cozumel, Mexico. For $3, snap-happy tourists can email a video postcard home. Nothing says "wish you were here" like seeing Dad in a thong. – **Jennifer Kahn**

Wi-Fi in a box: Bell Canada's booth.
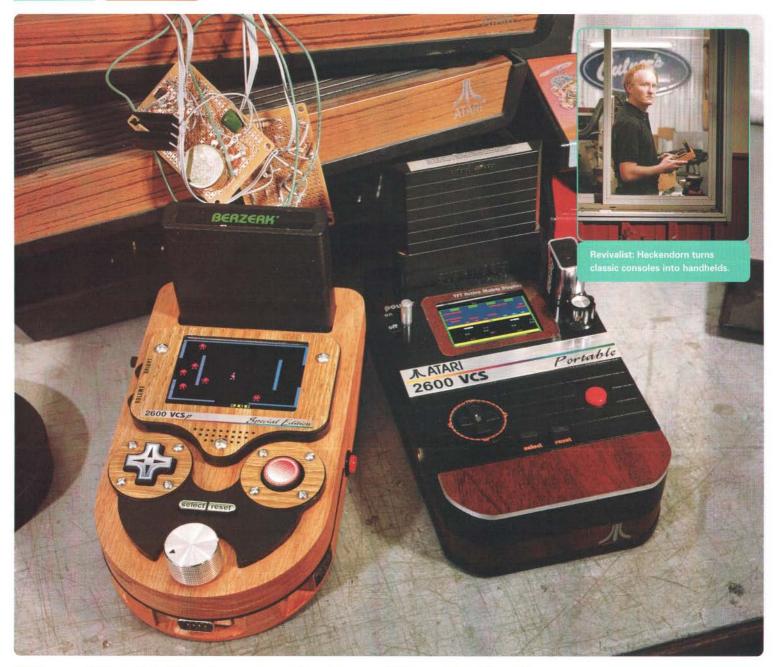
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Revivalist: Heckendorn turns classic consoles into handhelds.

The High Priest of the Atari Cult

Pity the obsolete gaming console – like that once-beloved Atari or Super NES you shoved in the closet or unloaded at Goodwill as soon as a hotter, faster system came along. But a few lucky cast-offs have made it into the hands of Benjamin Heckendorn, who rebuilds them as lithe little portables that run classic cartridges.

Heckendorn has refashioned 39 units out of old-school hardware. His signature model, the VCSp, is based on the Atari 2600, circa 1977. "It's a way to honor the old games. It lets people revisit something from

their past – kind of like when they're at a bar and they hear a Bon Jovi song," he says. "Besides, it's cool." Make that *supercool* in the realm of classic gaming, where Heckendorn, 27, has become something of a cult hero since single-handedly inspiring a new hobby. He's even sold his handiwork to fans for up to $600 a pop.

A graphic designer at Jim Greeley Sign and Awning in Richland Center, Wisconsin, Heckendorn builds the units on lunch breaks. Each one costs him about $200 in parts and 10 hours of labor. He uses the company's tool

shop (with the boss's blessing), routing and cutting out cases from solid plastic and oak.

Heckendorn taught himself electronics, starting with a RadioShack kit as a kid. He sacrificed 25 Atari consoles to figure out how to make the old systems new again. First, he rewired the 9- by 5-inch circuit board of the original 2600. Then he cut it down to 4 inches square and added a store-bought mini color TV and a Sony InfoLithium camcorder battery. His VCSp allows two hours of gameplay on a single charge. So much for obsolescence. **– Stuart Luman**

MICHAEL LEWIS

SAMSUNG

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Your day starts and ends with communications, which can now be truly exciting. Technology breakthroughs by Samsung Telecommunications lets you do unimaginable things with your mobile phone like shooting and sending your own film clips or video-conferencing in real time. Samsung Telecommunications offers the tools for endless mobile possibilities, anytime and any-place. Get the most out of your communications with Samsung. Go for it!

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The Bleeding Edge

Emergency medical response time has sped up considerably since 1797, the year Napoléon's surgeon general declared that soldiers must be transported to a hospital within 24 hours of being wounded. Today, the standard in the US – where 40,000 ambulances respond to half a million 911 calls a day – is eight minutes or less. The most advanced vehicles pack everything from wireless webcams to magnet-controlled respirators. Coming soon: smart bandages. Here's a peek inside a University of Maryland bus. – **Joshua Davis**

1
Telemedicine
There may be only one paramedic in the back of each University of Maryland ambulance, but there's a whole team of ER physicians and nurses watching the patient's progress via webcam. The hospital recently outfitted three vehicles with a Northrop Grumman system that combines Wi-Fi and cell bandwidth to form one fat feed. It can transmit 20 Kbits of data per second – enough to zap a series of sharp images to the emergency room.

2
Emergency Chatrooms
Prompted in part by communication failure on 9/11 – paramedics were calling dispatch centers to get in touch with cops 20 yards away – Washington, DC, is building CapWIN, the nation's first wireless multi-state emergency network. Set to go live by year's end, the IBM-built system will allow police and rescue squads in DC, Virginia, and Maryland to compare notes during an incident. The encrypted chat rooms will be accessible through PDAs and laptops.

3
Enter the Oxylator
When a patient starts to turn blue, many EMTs rely on the new Oxylator EM-100 instead of the old CPR bag. The device uses a magnet-controlled valve that senses the patient's airflow – or lack thereof. The Oxylator has greatly reduced the problem of multitasking paramedics overfilling patients' lungs. US Special Forces medics have adopted the machine as a standard, and they used it in Afghanistan last year.

4
Smart Bandages
In March, researchers at the University of Rochester began a clinical study of bacteria-sniffing microchip probes. Eventually, they hope to embed a handful of the devices into a single bandage, which would be able to detect specific pathogens like salmonella, listeria, and *E. coli*. When a probe detects a bug, a small wireless transmitter on top of the dressing will notify an ambulance's onboard computer. Within 5 minutes, medics will know what they're up against.

5
The Sound of Sirens
Since the mid-1960s, electronic sirens have wailed, yelped, and hee-hawed. In New York City, medics have combined all three sounds to create pig- and cowlike noises to steer jaded city dwellers aside. (The *Journal of Emergency Medical Services* denounced the barnyard effects in 1990.) Lately, companies have been experimenting with wideband noise – static broadcast across several frequencies simultaneously – to help citizens distinguish the blare.

INSIDE THE SOUPED UP, FULLY LOADED AMBULANCE

TELECOM

Four Ways the FCC Screwed Up

When Michael Powell was tapped to head the FCC two years ago, his plan was to impose a little coherence on the regulatory landscape. But that was before the commission turned against him in February, voting 3-2 to muck things up instead. Revisiting the implementation of the 1996 Telecommunications Act – designed to bring some competition to local phone service – the anti-Powell majority freed the Bell companies from the obligation to make either their old copper wires or new fiber available to competing data carriers like Covad. And while the Bells are still required to open their voice lines to rivals, the crucial question of whether to include switches – the key to any network – was left for the states to answer. How badly did the FCC screw up? Let us count the ways.
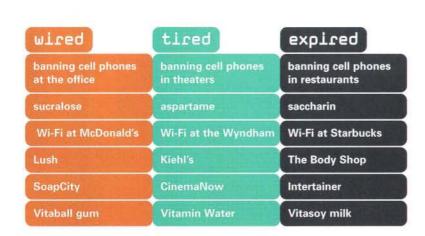
1. Casting regulators adrift. When Republican commissioner Kevin Martin persuaded the FCC's two Democrats to go along with his challenge, he ended the illusion that Powell – or anyone else – was in charge. And by letting state regulators decide on switches (an issue that will be litigated ad infinitum), he moved the question from one jurisdiction to 50. Or 51, if you count DC.

2. Unleashing the Bells. "They won't stay dead!" screamed the movie tagline for *Night of the Living Dead*, and so it is with the Bells. Seven years after the Telecom Act was supposed to loosen their grip, legacy telcos have a tighter hold than ever. Yeah, they've been told they have to yield on voice, but the future is in data, and there they've been freed to keep lurching.

3. Duping Silicon Valley. Infrastructure providers cheered the vote, thinking it would stimulate investment from the Bells and competitors alike. "What is the tech industry smoking?" retorts one prominent Beltway insider. Sure, the Bells had long claimed they couldn't be expected to invest in fiber networks and then share them with the competition at government-mandated rates. But as soon as the FCC lifted that restriction, Bell execs declared they wouldn't invest anyway. How could they, when there are lawyers and lobbyists to be fed?

4. Alarming Wall Street. Did we mention that investors hate a muddle? That's what the FCC delivered, and within two weeks the

Michael Powell vs. Kevin Martin
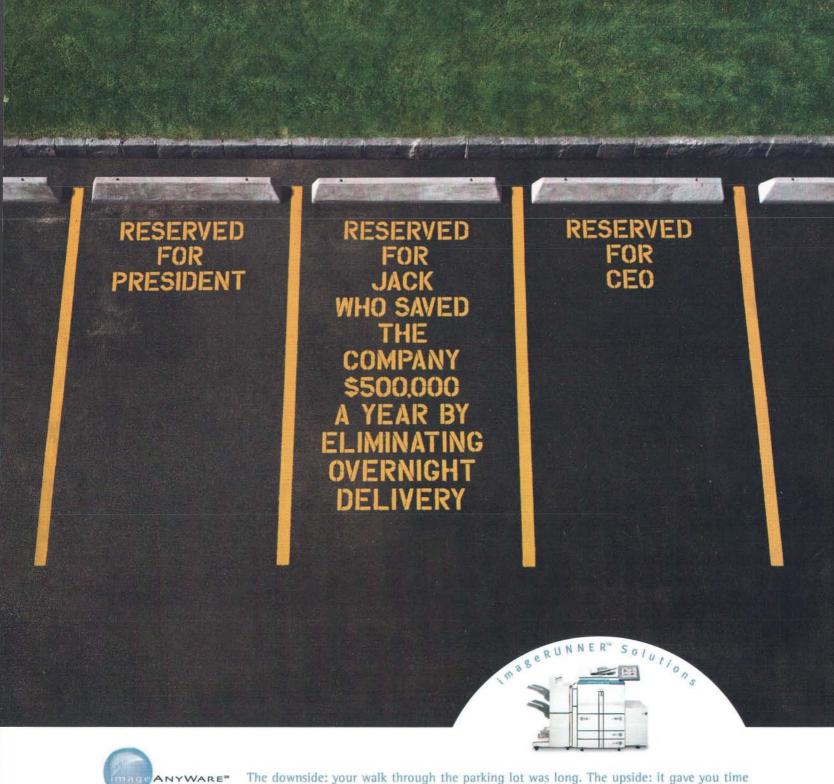
THE CHAIRMAN AND THE RENEGADE FACE OFF

telecom industry – carriers *and* suppliers – had lost an additional $30 billion in market capitalization.

If there's anything to be salvaged from this mess, it's the hope that alternatives will flourish. With demand for broadband growing and the Bells moving ever slower, something has to give. Wi-Fi is one potential solution: Under existing FCC rules, point-to-point antennas that boost signal range to a couple miles could provide a direct Net connection, no telcos required. Powell is intrigued. "There are reasons to believe that one day Wi-Fi might be able to do that," he says. "But 'might' is an important qualifier." Which is his way of saying that technology can be as full of question marks as any FCC decision. **– Frank Rose**

wired	tired	expired
banning cell phones at the office	banning cell phones in theaters	banning cell phones in restaurants
sucralose	aspartame	saccharin
Wi-Fi at McDonald's	Wi-Fi at the Wyndham	Wi-Fi at Starbucks
Lush	Kiehl's	The Body Shop
SoapCity	CinemaNow	Intertainer
Vitaball gum	Vitamin Water	Vitasoy milk

PULSE

What You See Is What You Get

The world of *The Matrix* might be a vast and convincing simulation (see "Matrix^2," page 112), but it isn't real. Fifty-four percent of 1,700 *Wired* readers polled are certain Earth is as it appears and not some alternate plane, or fifth-dimension fantasy, or projection of a higher power. Looks like the propaganda is working.

What are the chances we're living in a matrix?
- No chance — 54%
- 1-5% chance — 22%
- 6-20% — 6%
- 21-50% — 7%
- 51-80% — 4%
- 81-100% — 7%

MARK WASYL

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Money on the Table

VCs aren't investing like they used to, but they're still flush with the cash they raked in during the boom

The glory days of venture capital are over, but that doesn't mean VCs aren't ready to seize the next moment of opportunity. Far from it. Those who quietly hoarded the megabucks during the boom are now sitting on $80 billion of uninvested capital. And they're under increasing pressure to put the money to work: Private equity investments are expected to jump 50 percent this year.

Roughly a third of those funds will be earmarked for startups based in recession-weary Silicon Valley. The sector most likely to benefit: the battered and bloodied telecom industry, which in the fourth quarter of 2002 received about 12 percent of all venture financing, second only to the software business. Moreover, telecom startups, led by satellite broadband provider WildBlue Communications and its $156 million windfall, accounted for five of the top six deals sealed in 2002. Another potential winner: medical devices. Whereas investments in semi-conductors, Internet apps, and computer hardware are down anywhere from 60 to 90 percent, current backing of medical devices is actually on par with the go-go years.

Even if VCs decide to lie low a little longer, don't think there won't be another source of capital. According to the Center for Venture Research at the University of New Hampshire, some 300,000 angel investors pumped more than $30 billion into an estimated 50,000 US companies last year. Maybe this year, they'll go for broke. – Tom Stein

Five Years of Venture Capital

- INVESTMENT (in billions) — green
- UNINVESTED CAPITAL (in billions) — yellow
- NUMBER OF DEALS — orange

Year	Investment	Uninvested Capital
1998	$22	$42
1999	$55	$62
2000	$107	$96
2001	$41	$106
2002 (First three quarters)	$21	$80

Deal axis: 2,000 / 3,000 / 4,000 / 5,000 / 6,000

Top 10 Investments by Industry

	INDUSTRY	Q4 2002 INVESTMENT (in millions)	NUMBER OF DEALS
01	Software	$869	183
02	Telecommunications	$502	78
03	Medical devices and equipment	$486	57
04	Biotechnology	$474	61
05	Networking and equipment	$457	47
06	Semiconductors	$243	28
07	IT services	$218	33
08	Media and entertainment	$142	32
09	Industrial/Energy	$140	37
10	Computers and peripherals	$134	26

MARK WASYL

Under the Influence
As corporate funding of drug R&D grows, so do the pro-industry results
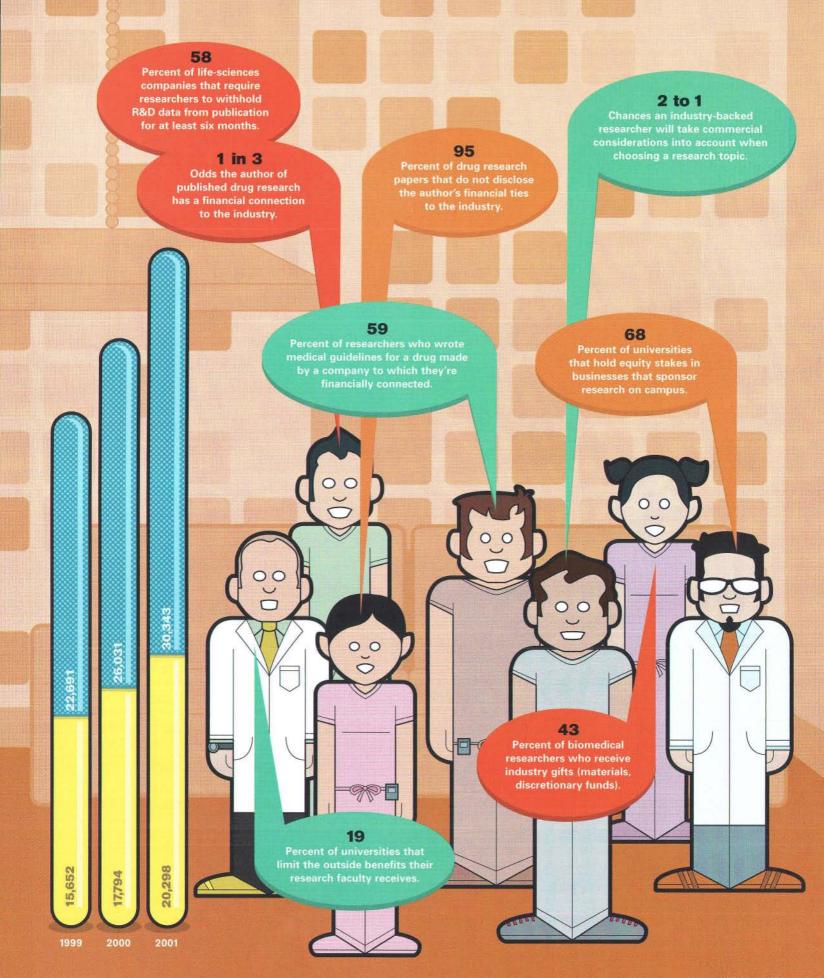
When it comes to drug R&D, you get what you pay for – especially if you're funding prescription meds. Nearly 75 percent of studies backed by pharmaceutical companies produce pro-industry results. On top of that, funding from corporate America has increased eightfold during the past 20 years, by far outstripping money from the federal government, once the main source of financing. In 1998, Big Pharma's spending rivaled the National Institutes of Health's whole budget; in 2001, the industry spent 50 percent more than the NIH.

How heavy is the corporate influence? A survey by the University of Toronto and Mount Sinai Medical Center linked nine out of ten drug researchers to the industry. Six received corporate funding and, on average, worked with 10 different firms. Only one in ten admitted to being swayed by industry connections, but two suspected coworkers were.

A Yale University School of Medicine study says that's an understatement. It found that researchers are more likely to provide results that favor an industry when backing comes from industry sources. Corporate sponsorship also influences how data is shared with colleagues and what gets published – two cornerstones of scientific objectivity.

– Patrick di Justo

Big Pharma's R&D Spending vs. National Institutes of Health's Total Budget
(in millions of dollars)

● INDUSTRY ● NIH

Year	INDUSTRY	NIH
1984	3,579	4,494
1985	4,078	5,149
1986	4,740	5,262
1987	5,502	6,183
1988	6,538	6,667
1989	7,330	7,145
1990	8,420	7,576
1991	9,705	8,277
1992	11,468	8,922
1993	12,740	10,336
1994	13,449	10,956
1995	15,207	11,300
1996	16,906	11,928
1997	18,958	12,741
1998	20,967	13,648

MARK WASYL

58 Percent of life-sciences companies that require researchers to withhold R&D data from publication for at least six months.

1 in 3 Odds the author of published drug research has a financial connection to the industry.

95 Percent of drug research papers that do not disclose the author's financial ties to the industry.

2 to 1 Chances an industry-backed researcher will take commercial considerations into account when choosing a research topic.

59 Percent of researchers who wrote medical guidelines for a drug made by a company to which they're financially connected.

68 Percent of universities that hold equity stakes in businesses that sponsor research on campus.

43 Percent of biomedical researchers who receive industry gifts (materials, discretionary funds).

19 Percent of universities that limit the outside benefits their research faculty receives.

22,691
26,031
30,343
15,652
17,794
20,298
1999   2000   2001

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5 — AMERICAN IDOL
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Reflections of Our Past
JOHN H. RELETHFORD

20 — DARK ANGEL
Fear not. Fox may have canceled the show, but you can get your fill of the cycle-riding sci-fi hottie as she fights through the first season on DVD, out today. darkangeltheseries.com

14 — CANNES FILM FESTIVAL
Rumors circulate that Lars von Trier will return to the French Riviera – this time with his A-list film *Dogville*. festival-cannes.com

15 — "BRAINGIRL" + "E" + "PUSSYWEEVIL"
Former *Artforum* reviewer Claudia Hart practices what she critiques in her animation installation, debuting at New York's Bitforms gallery. bitforms.com

29 — BIRTHDAY: DANNY ELFMAN
Oingo Boingo rocked. But frontman Elfman scored big by penning mood music for flicks like *Spider-Man* and *Batman*. Can't wait to hear what the 50-year-old does with *T3*.

8 — GAME DEVELOPERS WORLD 2003
Hitman 2 developer Thomas Jakobsen shows a Copenhagen crowd that videogames aren't just digital entertainment — they're works of art. www.gd-world.com

16 — E3
It's Game Over as the LA Convention Center closes its doors to the videogaming masses. If you haven't gotten your pixel fix by now, seek medical attention. e3expo.com

30 — WIRELESS CONNECTIONS 2003
Are all VCs veering toward the unwired world? Day two of this Canadian conference shows you the money. wirelessconnections2003.com

23 — THE PETER SAVILLE SHOW
The artist behind many a New Order and Joy Division album covers exhibits his private collection of designs in London. May the '80s never die. designmuseum.org

9 — DADDY DAY CARE
Still unemployed? Follow Eddie Murphy's lead. The post-bust capitalist tries baby-sitting in this big-screen comedy, which opens today. sonypictures.com/movies/daddydaycare

2 — X2
Marvel's mutants are back. Will Cyclops give Magneto the eye or run the evildoer down with his flashy new Mazda RX-8? Decisions, decisions. x2-movie.com

17 — INT'L CONTEMPORARY FURNITURE FAIR
Style queens hit NYC in search of swank accoutrements for their homes. The real steal of the day: a peek at bad-boy designer Marc Newson. icff.com

18 — ANIME CENTRAL 2003
Where are your D&D mates now? In Illinois, rocking out to anime cover band SWEK and feeding their senses with six rooms of animation. acen.org

4 — TOP THRILL DRAGSTER
It goes from 0 to 120 mph in four seconds and peaks at 42 stories aboveground. The world record-breaking coaster launches today in Ohio. If you get on, you'll get off. cedarpoint.com

PLAY
Culture • Gear • Obsessions

Swimming With Sharks

How do you make $1.7 billion at the box office? Introduce the world to digital animation and never stop upping the ante. That's what Pixar has done since 1995 with its CG toys, insects, and monsters. Now the company aims to hook that elusive Oscar for Best Animated Feature with the aquatic adventure *Finding Nemo*, which Disney releases May 30. To get their feet wet, the film's crew became licensed scuba divers, installed an aquarium in the office, and watched hours of *The Blue Planet*. After all, *Nemo* needs to make a splash. Longtime competitor PDI/DreamWorks is hot on the animation house's tail fin with *Sharkslayer*, an underwater mob movie. Here's how Pixar is staving off the "Shrekking of America." – **Bill Desowitz**

PIXAR GOES DEEP TO REEL IN ITS NEXT BLOCKBUSTER

An Animation Timeline

Toy Story (1995)
Pixar made the world's first all-CG feature. Two apps replaced tedious hand-drawn, frame-by-frame animation: RenderMan spat out each of the movie's 1,560 shots, and Menv endowed 3-D characters with articulation controls.

A Bug's Life (1998)
With PDI/DreamWorks' *Antz* due the same year, Pixar had to get even more real. The tech coup: subdivisional surfacing, a modeling method that flexibly represents points in space. It gave Flik the ant 320 facial controls, more than twice that of *Toy Story*'s Woody.

Toy Story 2 (1999)
Pixar mostly relied on old tricks to crank out this sequel, which had an incredibly short nine-month production cycle.

Monsters, Inc. (2001)
The studio's secret weapon: the physics algorithms of FizT, which allowed the 3 million hairs in Sulley's blue coat to correspond with the character's movement. Plus, Pixar doubled its computing power from *Toy Story 2*, to 2.5 million RenderMarks.

Finding Nemo (2003)
The Little Mermaid was a fingerling compared with *Nemo*. This underwater world undulates in response to currents, captures the flapping of fish, and deftly reproduces the ocean's murk. To get this look, the Pixar brain trust built a water simulator and a tool that lays out three-dimensional paths for the fish to follow.
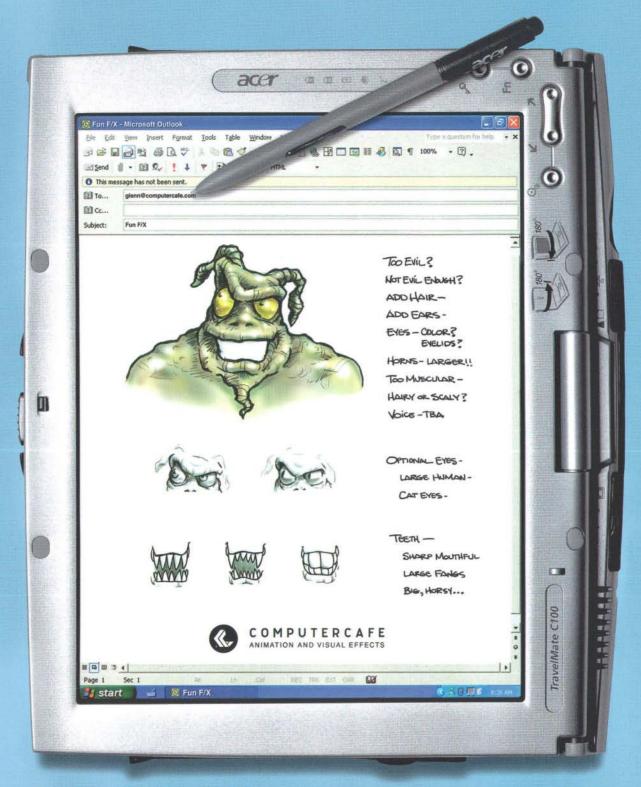
Their ideas, captured.

In the hands of David Ebner and Jeffrey Barnes.
It's a laptop. It's a simple pad and pen.
It's the Tablet PC running
Microsoft Windows® XP Tablet PC Edition.
microsoft.com/tabletpc

UNWIRED

Get Wireless!

EVERYTHING YOU NEED TO KNOW ABOUT THE WI-FI REVOLUTION

10 People to Watch

Build Your Own Network in **6** Easy Steps

The **5** Next Big Things

PLUS:

How Wi-Fi is Changing the Way We Work & Live

The Complete Guide to the Best Gadgets & Services

Unwire the big idea.

Ethernet, wireless and dial-up, all spoken here.

Switching from network to network is a snap with Access Connections on the IBM ThinkPad notebook.

Like a mobile interpreter accompanying you, Access Connections on the ThinkPad® notebook can help you connect in a variety of locations. Access Connections is a part of Access IBM, which offers a wealth of support to simplify access to online (requires Internet access account; not included) and on-system information and helps answer questions. The ThinkPad notebook also has other features which make life easier, like integrated wireless (on select models) and the preloaded IBM Rapid Restore™ PC software. It's a recovery solution that helps restore previously saved data, including applications and operating systems, quickly and easily. And for outstanding connectivity, performance and mobility – new Intel® Centrino™ mobile technology is on select ThinkPad notebooks to power it all, virtually anywhere work takes you.

intel inside™
centrino™
MOBILE TECHNOLOGY

IBM ThinkPad X31

Unwire the meeting.

CONTENTS

from the editors

WI-FI is here.
NOT SINCE the birth of the Web has a new technology offered so much possibility. The past decade has seen a growing fascination with all things wireless, from mobile phones to two-way pagers to GPS handhelds. Now Wi-Fi is unwiring the Internet itself, linking our gadgets and changing how we communicate with each other, entertain ourselves, and use our public spaces. Best of all, the Wi-Fi revolution has been organic, up from the grassroots and unfettered by government regulation. **WIRED** is committed to making sense of a fast-changing world, and we've covered wireless innovation all along. Today, as Wi-Fi pushes further into the mainstream, we offer the ultimate user's guide. So what to call it? In a recent issue, the legendary Arthur C. Clarke suggested it was high time we listen to the technology and change our name to *Unwired*. For one issue we'll give it a try.

Cover photograph: Jill Greenberg

the wi-fi revolution

BY
CHRIS ANDERSON

The wireless Internet has arrived – and now the sky's the limit.

WE STAND AT THE BRINK

of a transformation. It is a moment that **echoes** the birth of the Internet in the mid-'70s, when the **radical pioneers** of computer networking – machines talking to each other! – hijacked the telephone system with their first **digital hellos.** Or that **jaw-dropper** a decade later when the FCC official whose job it was to track the growth of communications networks **suddenly realized** that his neat tabulation of local and long-distance had been made moot by the **unforeseen rise** of local-area networks: an **unregulated, unmonitored, uncontrollable** phenomenon of the upstart PC industry that would soon **shake the telecom world.** Or the arrival of the Web browser, which **blew millions** of minds, making a mouseclick feel like **teleportation.** ◎ This time it is **not wires but the air** between them that is being transformed. Over the past three years, a **wireless technology has arrived...**

Wi-Fi Explained

Wireless networking comes in a variety of flavors, all of them identified by a string of numbers and letters only a librarian could love. Beware: Not all standards are created equal.

802.11b

The standard that started it all. Seeking to invent a speedy way to send data via unlicensed airwaves, engineers working on a standard for wireless local-area networks borrowed from existing technologies – Ethernet's data packets, the Internet's routing protocols, and spread spectrum's use of many channels within a frequency band. The result is information delivered at speeds up to 11 Mbps in the 2.4-GHz band, and at a range of about 300 feet. In 1999, an industry group wisely decided to give it a more friendly name and settled on the retro-chic Wi-Fi, for wireless fidelity.

802.11a

Finalized four years ago, 802.11a works in the 5- to 6-GHz band at speeds of up to 54 Mbps. Products based on the standard were first introduced in late 2001. Its strengths: high speed and lower risk of radio frequency interference than either 802.11b or 802.11g. Its weakness: *a* is incompatible with the more popular *b* and the emerging *g*, because it strayed from the 2.4-GHz band. As a result, some manufacturers have quit building products for it. But as WLANs proliferate, it could prove essential to serving large populations in concentrated area, such as downtowns, universities, and business centers.

802.11g

The much-anticipated 802.11g has already been revised six times; approval is expected in mid-2003. Why all the excitement? It promises complete interoperability with *b* and transmission rates up to five times faster in the same 2.4-GHz band. Early products are already on the market from Wi-Fi heavyweights such as Apple, Linksys, Netgear, and D-Link. Among the challenges for *g*: higher vulnerability to radio frequency interference from other 2.4-GHz devices, such as late-generation cordless phones.

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with the power to totally change the game. It's a way to give the Internet wing without licenses, permission, or even fees. In a world where we've been conditioned to wait for cell phone carriers to bring us the future, this anarchy of the airwaves is as liberating as the first PCs – a street-level uprising with the power to change everything.

The technology is Wi-Fi, and it's the first blast in a revolution, called open spectrum, that will drive the Internet to the next stage in its colonization of the globe. Like the Net itself, Wi-Fi was confined to technical circles for years before exploding into the mainstream, seemingly out of nowhere. Over the past two years, it's become one of the fastest-growing electronics technologies in history.

What makes the new standard so alluring? Wi-Fi is cheap, powerful, and, most important, it works. A box the size of a paperback, and costing no more than dinner for two, magically distributes broadband Internet to an area the size of a football field. A card no larger than a matchbook receives it. The next laptop you buy will probably have Wi-Fi built in. Wires may soon be for power alone.

But the appeal goes deeper. Wi-Fi represents a fundamentally different approach to the airwaves that could lead to a new era of wireless policy. Like other open spectrum technologies rising in its wake, Wi-Fi is a way to use the handful of frequencies set aside for

unrestricted consumer use. That's true of the old CB radio, too, but unlike the trucker channels Wi-Fi is digital and smart enough to avoid congestion. After 100 years of regulations that assumed serious wireless technologies were fragile and in need of protection by monopolies on exclusive frequencies (making spectrum the most valuable commodity of the information age), Wi-Fi is fully capable of protecting itself. It has turned the airwaves into a commons without tragedy, and turned the economics of wireless on its head.

Among the geeks, Wi-Fi has become a fascination, a glimpse of the future of the Internet. Like the Web, it's open, unregulated, and free. It doesn't require a loyalty oath to some corporate behemoth. Anyone can deploy it, and millions have. For many it's an epiphany – the unforgettable impact of being in the presence of something important and new.

No one has been more startled by all of this than the big cellular companies, which paid dearly for transmission rights just a few years ago. Flush with the success of digital phones, they expected the next big thing to emerge the same way. US firms were focused on catching up with their European rivals, who in turn were obsessed with the prospect of ruling the next great technology era (take that, Silicon Valley!) with so-called 3G networks, which would offer multimedia

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People to Watch
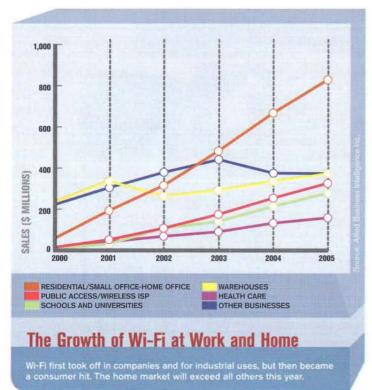
Introducing the innovators, rebels, and policymakers who are leading the wireless revolution.

Anthony Townsend and Terry Schmidt ◄ the pirates

The most famous Wi-Fi node in the world, in midtown Manhattan's Bryant Park, went live last June, switched on by Anthony Townsend, who teaches urban planning at NYU, and his free-wireless comrade, Terry Schmidt. By the end of the summer, the network was drawing 50-plus users a day and had transformed the duo's organization, NYCwireless, from a bunch of bandwidth pirates into a respected champion of public access. Their pitch: Any neighborhood can go wireless, for as little as $1,000. "Bryant Park spends almost as much on rat poison every year," says Schmidt. The two are now at work on a new, eight-node "walking network" that will put every part of downtown within a five-minute walk of free Wi-Fi. – Lucas Graves

SALES ($ MILLIONS)

Y-axis: 0, 200, 400, 600, 800, 1,000
X-axis: 2000, 2001, 2002, 2003, 2004, 2005

Legend:
- RESIDENTIAL/SMALL OFFICE-HOME OFFICE
- PUBLIC ACCESS/WIRELESS ISP
- SCHOOLS AND UNIVERSITIES
- WAREHOUSES
- HEALTH CARE
- OTHER BUSINESSES

Source: Allied Business Intelligence Inc.

The Growth of Wi-Fi at Work and Home

Wi-Fi first took off in companies and for industrial uses, but then became a consumer hit. The home market will exceed all others this year.

Top 10 Unwired Cities

Looking for a Wi-Fi hookup? Based on the number of access points in business districts, airports, and parks, we ranked the most Wi-Fi friendly US cities.

	CITY	COOL HOT SPOT
1	San Francisco	Levi Strauss Plaza
2	New York	Bryant Park
3	Seattle	Any of 77 Starbucks
4	Chicago	O'Hare airport
5	Atlanta	Four Seasons
6	Los Angeles	Downtown Long Beach
7	Dallas	Crossroads Market Bookstore & Café
8	Washington, DC	Tryst Coffeehouse and Bar
9	Twin Cities	Mall of America
10	San Jose	San Jose International Airport

on a new generation of do-everything smartphones. But the 3G dream was already in trouble. The technology wasn't working well, and amid the telecom bust, the $100 billion European carriers borrowed for spectrum licenses was starting to seem like a colossal mistake.

Then came a bolt out of the ether: Consumers realized there was a way to get wireless Internet that didn't require phone companies at all. Wi-Fi had arrived, and it did what it promised right out of the box. Cheap Wi-Fi packages started showing up on the shelves of Wal-Mart and Best Buy, and they sold in remarkable numbers: 12 million units last year, and on pace to double that this year.
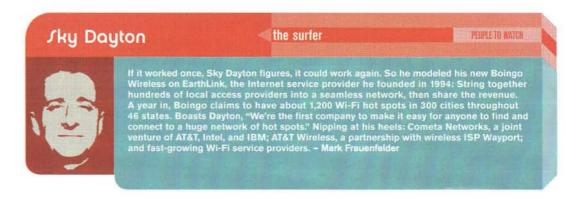
What's extraordinary about this boom is that it's an authentic grassroots phenomenon, happening in the home even faster than in the office. Companies are cautious about the security implications of a network that goes through walls and into the street, but most home users are too dazzled to care. Anyone with a broadband connection can plug a $100 access point into a cable modem or DSL box, slip a $60 card into a laptop, and suddenly have that most fabled of tech ambitions: Internet everywhere, or at least everywhere around the house. Stream video from the couch, surf in bed, email in the backyard, all at lightning speed. How many other technologies leave even hardened gadget vets grinning with amazement?

And that's just the beginning. We are starting to see the next phase of the Wi-Fi movement: the rise of public networks. Already there are thousands of open-access hot spots across the country, everywhere from Starbucks and airports to city parks. Others are ad hoc community nets, such as neighboring apartment dwellers using Wi-Fi to share a broadband connection. Tens of thousands more are accidental, leaking out of private homes or offices and often free for passersby to hitchhike on. With prices for Wi-Fi equipment continuing to plummet, it's just a matter of time before the scattering of Wi-Fi dots on city maps grow dense and then overlap.

In the years ahead, Wi-Fi will become a universal standard, found everywhere in the electronics world. It will show up in consumer electronics devices, from videogame consoles to music players. Cell phones will have it, as will PDAs and digital cameras. Any PC bought in a year or so will instantly become the hub of a wireless network, simply by turning it on. The numbers will quickly reach true mass-market levels: an estimated 99 million people with Wi-Fi by 2006, according to Gartner.

All of this amounts to an inversion of the usual adoption cycle, where big companies must build communications infrastructures

ƒky Dayton

the surfer — PEOPLE TO WATCH

If it worked once, Sky Dayton figures, it could work again. So he modeled his new Boingo Wireless on EarthLink, the Internet service provider he founded in 1994: String together hundreds of local access providers into a seamless network, then share the revenue. A year in, Boingo claims to have about 1,200 Wi-Fi hot spots in 300 cities throughout 46 states. Boasts Dayton, "We're the first company to make it easy for anyone to find and connect to a huge network of hot spots." Nipping at his heels: Cometa Networks, a joint venture of AT&T, Intel, and IBM; AT&T Wireless, a partnership with wireless ISP Wayport; and fast-growing Wi-Fi service providers. – Mark Frauenfelder

SALES ($ MILLIONS)

Chart axis: 0, 200, 400, 600, 800, 1,000 (vertical); 2000, 2001, 2002, 2003, 2004, 2005 (horizontal)

Source: Allied Business Intelligence Inc.

- ■ NORTH AMERICA
- ■ ASIA-PACIFIC
- ■ EUROPE
- ■ REST OF THE WORLD

The Growth of Wi-Fi Around the World

North America, where most of the big Wi-Fi makers are based, leads the market today. But in Asia Wi-Fi often represents the first broadband technology deployed, rather than a replacement for something else, and as a result it is rising fast.

to encourage consumers to jump on new technologies (as was the case with cell phones). Wi-Fi is becoming ubiquitous for its own reasons. The question is, what networks and services will arise to capitalize on it? Rather than "build it and they will come," the mantra is "they're already here, now build it!"

But build what, exactly? Here are the next four big fronts in the Wi-Fi invasion.

Making it work everywhere. Today the gap between a cell phone experience and Wi-Fi is huge. With a phone, it's usually safe to assume you've got a signal; with Wi-Fi it's almost always safe to assume you don't. Even in the presence of a hot spot (and there are few good ways to know you are, short of opening your laptop and "sniffing" for it), odds are you won't be able to log on, because it's either a private network or a commercial one that requires a subscription. Even places that advertise access, such as hotels and airports, often have it just in the lobby or at certain gates.

Several companies are working on key chains, cards, and pendants that will glow in the presence of a Wi-Fi signal, which is a start (especially if they are smart enough to identify only the networks you can log on to). Cell phones could do the same. But until commercial hot spots are widespread and roaming agreements are in

place between them, public Wi-Fi will continue to be more like the Internet café experience, where you have to seek out access, than the cell phone experience, where it finds you. Companies such as Boingo and Cometa are aiming to achieve this, but it's a big world out there. Expect a few more years of frustration.

Unwiring the living room. Digital media, from MP3 to DVD, is taking over, but the equipment in most homes is still largely analog. Consumer electronics makers have been unable to come up with a common digital standard to link gear, and even if they did, few consumers want to string networking cable under their couch.

Wi-Fi can break this logjam and become the common link that ties together music, video, and even phones around the house, automatically and effortlessly. Then the notion of a central entertainment server, which records TV, stores music and video, and plays it back on any screen in the house, will finally take off. Once the living room is a wirelessly networked digital media hub, the long-awaited era of Internet video may arrive, kicking broadband demand into high gear.

Using Wi-Fi to cross the last mile. As consumer electronics start to ship with wireless networking built in, demand will skyrocket for the broadband connections to make it all worthwhile. Which could be another opportunity for Wi-Fi. Currently, getting broadband at

ILLUSTRATION BASED ON PHOTOGRAPH BY JAMES COLEMAN

Unwire the cubicle.

quality and reliability

ultimate connectivity

computing

act and flexible design

perfect blend of mobility and performance

Fujitsu recommends Microsoft® Windows® XP Professional for Mobile Computing

Free the Air!

AS BIG AS IT IS, Wi-Fi is just the start of something even bigger: a set of "open spectrum" technologies that could rewrite the rules of the airwaves, reversing a century of regulatory policy and enabling an explosion of new wireless devices and services.

The notion that wireless users, like airplanes in a landing pattern, need to be fenced off by themselves is an anachronism, a throwback to the days of analog. Radio signals are not like physical objects, which cannot occupy the same space at the same time without a crunch. Electromagnetic waves pass through one another effortlessly, and they can be extracted from a sea of other signals, even on the same frequency bands. The trick is knowing what you're looking for.
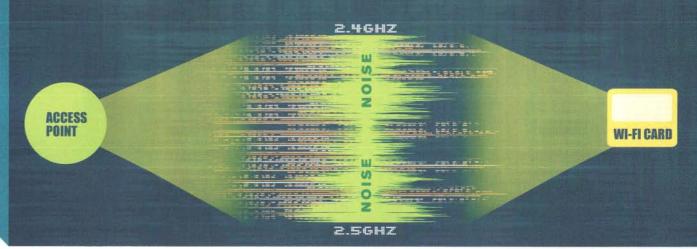
Two technologies have made that easier. The first is spread spectrum, which is a way of scattering a transmission around over many narrow frequencies, shotgun-style. Even if some are drowned out by interference, others will still get through – noise is rarely evenly distributed. And because the receiver knows the sequence of frequencies that the transmissions will be coming in, it can ignore those arriving at different times.

The second is digital radio, which can break up a transmission into Internet-like packets with addresses. DR receivers pay attention only to the packets meant for them, allowing many devices to use the same frequencies. Add error correction and the ability to resend any part of a message that is lost, and you have radios that can cut through the noisiest environments and share airwaves with hundreds of nearby transmitters.

On the back of the Wi-Fi phenomenon, a growing cadre of open spectrum activists are now pushing for wholesale changes in telecom regulation, extending the same principles to the rest of the wireless world. How much lower would your cell phone bill be if carriers didn't spend billions for licenses? How much closer would you be to broadband Internet in your pocket? The only thing that has kept the venerable landline alive for so long is the assumption that the airwaves were too limited to be shared by all. Once we thought the same about the Internet itself. **– C.A.**

Open spectrum technologies cut through the noise rather than requiring regulatory protection from interference. One key technique is spread spectrum, a way to transmit over many frequencies simultaneously; if some channels are blocked, others will let data through. Wi-Fi spreads its signal over 14 channels on the 2.4-GHz band.

2.4GHZ

NOISE NOISE NOISE NOISE

2.5GHZ

ACCESS POINT

WI-FI CARD

Ken Biba

◀ the distance runner   PEOPLE TO WATCH

Ken Biba helped develop TCP, the connection protocol at the heart of the Internet. Now, as CEO of Vivato, he's again at the center of a revolution. So far, Wi-Fi has been confined to local networks, because its limited range means you'd need up to 2,000 nodes to cover, say, a university campus. But Vivato's switching technology – the first in the industry – extends reach from roughly 30 feet to 4 miles. You'd need just 30 to 50 Vivato switches to turn all of Dartmouth into a hot spot. And it may go further than that. "Data can't travel on a voice network, but voice can travel on a data network," says Biba. Watch out, Grandma Bells. – Jessie Scanlon

SALES [$ MILLIONS]

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |

Source: Allied Business Intelligence Inc.

- 802.11b
- 802.11a
- 802.11g
- DUAL-BAND 802.11

The Rise of Multiband 802.11

802.11b, the most popular Wi-Fi standard today, has peaked, while 802.11g is on the rise. Both will eventually be passed by multiband devices.

Wi-Fi-equipped computers, microwave ovens, cordless phones, Bluetooth devices, and medical and scientific equipment all share the 2.4-GHz frequency range.

home is, at best, an uninspiring choice between the phone company and the cable company – if it's available at all.

Wi-Fi hot spots mounted on lampposts or telephone poles, with directional antennas to extend their range and avoid congestion, could offer as good or better service. And the economies of scale of a truly mainstream technology could make it far cheaper than other wireless options. Also, neighborhood Wi-Fi "umbrellas" could employ the miles of unused fiber-optic cable that are a legacy of the telecom bubble, effectively bridging the otherwise expensive "last mile" from the main telecom networks to individual homes.
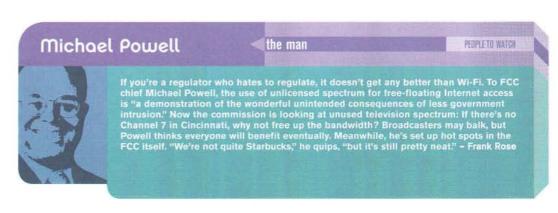
Converging with the cell phone. Finally, once there's widespread Wi-Fi in the home, the neighborhood, and enough public spaces, wireless convergence starts to make sense. Today, it's not uncommon to find consumers who are fully wireless: a cell phone outside the home, cordless phones within, and a Wi-Fi network for data. Yet, while some of these devices share the same frequencies (cordless phones and Wi-Fi both use the 2.4-GHz and 5-GHz bands), they are based on different standards and can't talk to each other.

Bringing them together is just a matter of time. Wi-Fi, especially in higher-speed incarnations, is as capable of transmitting voice as any cordless phone, and because calls travel over the Internet rather

than over a phone network, they are far cheaper. By the same token, several companies are planning to add Wi-Fi to cell phones, allowing users to make calls over the Internet when in Wi-Fi range. The dream to emerge from this is a single device that moves seamlessly from home to road, using the best network available wherever it is.

It's this vision of convergence that has the smarter telcos reconsidering their 3G plans in light of the Wi-Fi boom. There are many parts that still must come together, but it is not hard to imagine a day when the Internet really is everywhere, just in different strengths and price tiers depending on the cost of the underlying infrastructure. Your phone might be free to use at home and in the office, cheap in your neighborhood and downtown, free again at a café trying to boost business, and relatively expensive on the highway. Most of those would be Wi-Fi networks, with cell phone service as a seamless but costly fallback, like analog roaming is for digital phones today.

Wi-Fi is just a few years old – still in its first blush of success. No doubt some of the above will prove impractical, and problems from security to interference will arise to slow its growth. But it has already proven gloriously disruptive, as all great technologies are. Will it shake the cell phone industry? We don't yet know. But the golden age of wireless has only just begun. Give it time. ■ ■ ■

Michael Powell   ◄ the man

If you're a regulator who hates to regulate, it doesn't get any better than Wi-Fi. To FCC chief Michael Powell, the use of unlicensed spectrum for free-floating Internet access is "a demonstration of the wonderful unintended consequences of less government intrusion." Now the commission is looking at unused television spectrum: If there's no Channel 7 in Cincinnati, why not free up the bandwidth? Broadcasters may balk, but Powell thinks everyone will benefit eventually. Meanwhile, he's set up hot spots in the FCC itself. "We're not quite Starbucks," he quips, "but it's still pretty neat." – Frank Rose

ILLUSTRATION BASED ON PHOTOGRAPH BY CORBIS

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Sony recommends Microsoft® Windows® XP Professional for Mobile Computing.

AM radio	Shortwave radio	Garage door openers	FM radio	TV	Cordless phones	GPS
.5-1.7 MHz	1.7-30 MHz	40 MHz	88-108 MHz	600 MHz	900 MHz	1.2-1.66 GHz

Ultrawideband (all bands)

Garage door openers
It's not just transmitters in the car; some garage doors have wireless keypads.

wireless country

BY
XENI JARDIN

ILLUSTRATION
BY XPLANE

Every day and everywhere, we are surrounded by the radio chatter of intelligent machines. Wireless connected the world a century ago, and it is doing it again, in ways Marconi could never have imagined – man to message, device to device, Earth to space and back again. Here, a selected guide to life unplugged.

UPS tablets
The driver logs a signature and upon return relays it to a server as proof of delivery.

Kitchen convergence
Load dinner in the smart microwave in the morning, then email it instructions when it's time to cook. (In the meantime, it keeps food cool.)

Vehicle loggers
Can't find your car? A remote manager is alerted – and GPS helps find it.

Cell phones
Can you hear me now? Good.

Pet training devices
Fido wears a device that administers a mild electric jolt when he strays out-of-bounds or misbehaves.

GPS telematics
Drivers can get help with navigation and traffic conditions.

Mobile computing
Handheld devices with QWERTY keyboards from Handspring, Palm, and RIM offer email and Web browsing.

Mobile gaming
A new generation of wireless data networks has made cell phone gaming actually fun. Downloadable retro hits run great on Java phones.

Engage Ravioli

Cell phones	Bluetooth	802.11b 802.11g	802.11a	Industrial and commercial	Satellite TV
1.8-2.1 GHz	2.4 GHz	2.4 GHz	5 GHz	5.8 GHz	12 GHz

Industrial apps
Workers can monitor equipment and control robotic devices remotely.

Ultrawideband sensors
Soon, firefighters will wear devices that track them inside burning buildings or through cement walls.

Fast passes
A transponder tag in your car pays your toll as you drive by the booth.

RFID
Track retail inventory with cheap radio-frequency ID tags on goods; at home attach "beeper disks" to anything that could get lost.

Corporate Wi-Fi
Free the corporate LAN from the cube. Surf from the conference room and the cafeteria.

Intelligent traffic systems
If the streets know what's coming, signals and signs can direct vehicles to avoid congestion.

In-flight Wi-Fi
Log on in the air just by powering up your laptop.

Wi-Fi video
Download a movie to your hard drive, then beam it to your TV for viewing.

Public Wi-Fi
Hop on to the Internet from just about anywhere. Some services are free, some pay-as-you-go.

how to hook up

BY PAUL BOUTIN

A step-by-step guide to building your own network.

GETTING STARTED

All it takes is a broadband connection, a few hundred dollars, and a willingness to pull the plugs.

1 GET A BASE STATION

When it comes to buying equipment, think g, not b. New 802.11g hardware is nearly five times faster than 802.11b gear, and it will interoperate with that as well.

If you're a PC family, try the Linksys WRT54G 802.11g base. It will work on almost any Net connection, and the company often gives out software upgrades. It has a built-in firewall to stop hackers from plucking your credit card number from the airwaves, and a throughput jack lets you hardwire other computers via Ethernet cable. These should cost about $150.

If you're an Apple household, get an AirPort Extreme, about $200. It's prettier than earlier AirPorts, and newer Macs come with the software to run it.

2 BUY A CLIENT CARD

Linksys' 802.11g card (in both laptop and desktop versions) is a good deal for PCs. At about $75, it's 10 bucks more than the old cards yet will enable you to use the faster 802.11g bases.

For Apple owners, go to the Apple Store and buy whichever card the company offers for your computer: AirPort Extreme for top machines, AirPort 802.11b for the lower end. One of the newer PowerBooks has the card built in, and some new Macs come with the Extreme card.

3 TURN ON THE NETWORK

Simply plug your Internet connection into the base station and install the client card in your computer or laptop. Then turn on the base and your now-wireless computer. Wait as they find each other. Open a browser and try to go to a favorite site. If it works, congratulations: You've got Wi-Fi. If it doesn't, you most likely have to enter some ISP information into your base station's setup program. Check your manual.

Finally, rename your network. There's nothing more confusing than when two neighbors both have a network named "default" or "linksys." Pick something easy to remember, as users of older Windows laptops will need to enter it every time they join in.

EXTENDING RANGE

Smart placement of your gear and investment in a powerful client card will increase by a few yards the distance you can roam from your base station.

1 AVOID OBSTACLES

Usually, just moving the base from behind a wall or raising it higher off the ground will help it to reach all corners of your house. Keep it away from metal tables and dense filing cabinets, which can block radio waves.

Also, the signal strength of most bases and laptops isn't the same in all directions, but rather radiates along a plane that may not be pointing the right way for your needs. If your base has the usual "rubber duck" antennas, try tilting one straight up and one sideways, to cover different planes. If you have an AirPort or another unit with an internal antenna, stand it on end to see if it works any better.

If those simple steps fail, and you've got a Linksys 802.11b base, the company's $80 plug-in signal booster extends its range enough to cover most homes.

2 MOVE YOUR LAPTOP
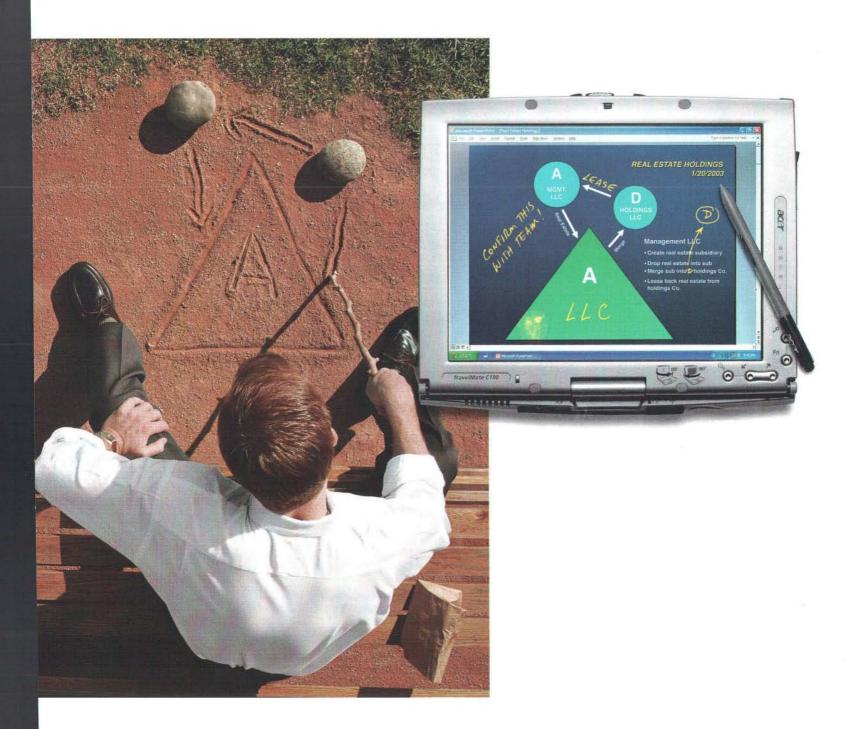
The more powerful your Wi-Fi card, the better. Most models run on 30 to 100 milliwatts. Hot-rodders go for the 200-milliwatt Engenius Ultra Long Range card. It's the most powerful card for sale in the US ... that meets FCC approval. Not only does it transmit farther, it's more sensitive to incoming signals.

As with the base, the card's antenna signal and receptions are strongest in one particular plane. You can often get a better connection by slightly tilting your laptop or facing a different direction.

3 FUTZ WITH THE ANTENNA

You've likely heard about people attaching a Pringles can to a base station or a laptop client card. And you've probably seen photos of "war-driving" teens with 3-foot antennas attached to their notebooks, looking to share someone else's network. Let them. You can try adding a smaller external antenna for about $100, but it may provide only a 10 to 15 percent range boost indoors. Spend your money on a more powerful card instead.

XPLANE

During lunch, in the park, a brainstorm. It's a laptop. It's a simple pad and pen. It's a Tablet PC.

A great idea may not wait until you get back to the office, back to your desk. The Tablet PC puts the full power of Windows® XP Professional in

a laptop computer that with a flip of the screen becomes as simple to use as a pad and pen. You write, draw, scribble, and erase directly on the

screen. Plus it runs all of your favorite Windows XP compatible applications. And built-in wireless support means whether you're in your office

or on the go, you have access to the information you need. For more information, visit microsoft.com/tabletpc

BEING SECURE

With enough encryption, even the CIA would have trouble reading your email. But additional safeguards can slow your network. Fortunately, there are some simple things you can do to keep out all but the most determined hackers.

1 CREATE A PASSWORD

If all you want to do is keep neighbors and passersby from hitching a free ride, you can close the network. Your base station's setup menus include an option to establish a mandatory logon password that everyone must type to connect.

To prevent anyone else from reconfiguring the base station, change its default password, too. Many base stations come with passwords like "admin" or "default," both of which are hardly original and easy to guess.

Closing your network won't prevent a dedicated hacker from breaking in or sniffing your online-shopping traffic for credit card numbers, but your home network is an unlikely target. Worry more about locking the car.

2 USE ENCRYPTION

If you intend to send sensitive email and spreadsheets containing confidential data, encrypt your data traffic with the Wired Equivalent Privacy protocol. As its name suggests, it's meant to make Wi-Fi as secure to use as a network cable.

The rub: Installing it can be tedious, so it's most suitable for businesses with IT staff. WEP works much like a basic network password, but logging on may require users to type in four computer-generated, 26-character cryptographic keys – gibberish like 0x4B90CD37BA128367F2A25AE527. Be prepared to assist visiting salespeople and other office guests.

WEP also has known security holes, so it will be phased out around the end of 2003 in favor of Wi-Fi Protected Access, a more robust encryption method with a user-friendly interface.

3 INSTALL A VPN

The most secure way to connect via Wi-Fi is a virtual private network, which creates an encrypted pipeline from your computer (through your base station) to an Internet gateway under guard at your ISP or company's server room. But you'll need an expert to set up and maintain this gateway. Ask your office IT staff if it has a VPN. Or, if you need security for personal use, Boingo includes one in its consumer-grade service plans.

The downside: Compatibility issues may keep you from connecting to your VPN through some wireless networks. Also, help can be hard to get on the road. At those times, you'll have to surf bare – if you dare.

SHARING YOUR NETWORK

You may be eager to include your neighbors and passersby. If your ISP permits sharing, remove the password from your network. Then these few extra steps will make your gift go farther.

1 TURN OFF PASSWORDS AND ENCRYPTION

Make it easy for others to get on. This will be scary for some people, but liberating once you realize potential eavesdroppers aren't interested in you. They want to use the bandwidth, not read your email.

2 INSIST ON SECURITY

If you'd like to keep a password and/or encryption on the network, set the network names to the URL of your homepage, e.g., www.paulboutin.com. Put contact info there for Wi-Fi users, who can request the password from you.

3 POSITION YOUR BASE STATION APPROPRIATELY

Remember, signal strength decreases as the distance between base station and laptop increases. Place your base as close as possible to a street, patio, or chairs where others will sit.

4 REGISTER YOUR HOT SPOT

Many Wi-Fi users go online to 80211hotspots.com, WiFinder.com, and NetStumbler.com to find hot spots, but the databases are only sparsely populated: Finding a hookup in, say, rural Maine could be tough. Submitting your network to these sites will make you a star.

TAKING IT ON THE ROAD

Finding networks is easy if you have the right tools and do your homework.

1 SNIFF WITH SOFTWARE

Windows XP and Apple's Mac OS X automatically build and update lists of available networks. But you'll get a lot more information by downloading software from NetStumbler.com, or its Apple counterpart, MacStumbler.com. These free programs tell you not just the names of available networks but how strong their signals are and whether they have encryption turned on.

2 SNIFF WITH HARDWARE

If you're wary of whipping out your precious laptop in strange places, carry iDetect's WFS-1 Wi-Fi Sniffer, a credit card-sized pocket device with LEDs that light up in the presence of a network. It's also good for walking around the room to find the strongest signal point before you settle down to work.

3 DON'T TAKE NO FOR AN ANSWER

Staff in hotels, coffee shops, and offices are often unaware there's a base station hidden right behind them. Double-check for yourself by touring the room with NetStumbler software or Wi-Fi Sniffer. If you can't find a signal in a hotel you know is networked, change rooms to get closer to a base.

4 DARE TO LOOK STUPID

Just like a cell phone, your wireless notebook is a radio with a built-in antenna. If you need to lock onto a weak signal, a little body movement can get you online while others are pounding their keyboards in frustration. Turn slowly in circles, raise your laptop up and down, hold it above your head like the Ten Commandments – hey, it beats taking a cab back to the hotel.

5 STOP AND SMELL THE COFFEE

Find a Starbucks, where you can get T-Mobile service – 2,000 hot spots and counting. The cost: a $6-per-hour charge to your credit card.

MAKING MONEY

If you're hoping to get rich off your home network, forget it. But if luring business travelers through your door is how you make a living, Wi-Fi can bring in extra customers and keep them there. They may even pay for the privilege.

1 ADVERTISE

Most businesses hide their base station in the back room. Why not set it out front in plain sight, with a clearly visible sign? Internet access may be just what shoppers rushing past are looking for.

2 GIVE IT AWAY

If you're a retailer looking to maximize foot traffic, take the simplest route: Set up an open network with no password, so anyone who walks in can get online instantly without your staff's help. Once they're logged on and settled down, they're yours.

3 OUTSOURCE

If you're bent on charging for Wi-Fi, hire somebody to run the operation. Boingo offers a plug-and-play solution for small businesses, while Surf and Sip may even come in and set up the system. These companies handle sign-ups, tech support, and billing, then send you a cut of the monthly take.

power tools

BY
NEIL McMANUS

Gearing up for the wireless life.

54G ROUTERS

The future of Wi-Fi is 802.11g, five times faster and backward-compatible with 802.11b, the current standard. Caveats: Web surfing – bottlenecked by your Internet connection, not these routers – will seem as slow as ever, and the first batch of products will need upgrades once g gets ratified later this year. That said, gimme-gimme folks already have a raft of zippy routers to choose from.

APPLE AIRPORT EXTREME BASE STATION
$199
www.apple.com

D-LINK AIRPLUS XTREME G DI-624 WIRELESS ROUTER
$149
www.dlink.com

LINKSYS WIRELESS-G ROUTER
$199
www.linksys.com

BELKIN 54G WIRELESS CABLE/DSL GATEWAY ROUTER
$150
www.belkin.com

POCKET PCS

The days of handhelds as glorified tip calculators are gone. The latest Pocket PCs are do-it-all marvels. The HP iPAQ h5455, for example, doesn't miss a bell or a whistle. Wi-Fi? Yep. Bluetooth? Roger. Biometric finger-print reader? Sure, what the heck. Check your email when you're out and about. This pumped-up device can connect to the Net through a mobile phone or Wi-Fi hot spot.

HP IPAQ POCKET PC H5455
$699
www.hpshopping.com

TOSHIBA POCKET PC E740
$549
www.shoptoshiba.com
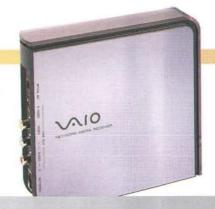
WIRELESS ETHERNET BRIDGES

One of the joys of online gaming is crushing opponents across the globe. Meanwhile, your Ethernet cable won't even let you across the room. Break loose with this bridge, which turns an Ethernet port into a Wi-Fi connection, making nearly any device – Xbox, PlayStation 2, laser printer, older PC – wireless ready.

LINKSYS WET11 WIRELESS ETHERNET BRIDGE
$119
www.linksys.com

D-LINK AIR DWL-810
$129
www.dlink.com

MEDIA RECEIVERS

Got a million MP3s but tired of burning CDs? Shoot your tunes to the stereo with a Wi-Fi media receiver. These machines come with remotes that let you choose songs and even playlists. Some handle more than music: The HP and Sony receivers grab photos from your PC and show them on your television screen. Sony's version, which works only with Vaio PCs and 802.11a networks, plays MPEG-2 video on your TV, too.

SONY ROOMLINK NETWORK MEDIA RECEIVER PCNA-MR10
$200
www.sonystyle.com

HP DIGITAL MEDIA RECEIVER EW5000
$299
www.hpshopping.com

MOTOROLA SIMPLEFI WIRELESS DIGITAL AUDIO RECEIVER
$379
www.motorola.com

TERRA PLAYER TR-100
$895
www.terraplayer.com

WIRELESS CAMS

Webcams are so '90s. Today exhibitionists use Wi-Fi cams with built-in Web servers that beam live, hi-res photos to the anonymous masses. The image quality is stunning, and the refresh rates approach full-motion video. Dubious? Feast your eyes on a state-of-the-art fishcam: *www.dlink.com/LiveDemo*.

D-LINK AIR DCS-1000W
$329
www.dlink.com

ADVANTEK NETWORKS CAS-200W
$295
www.advanteknetworks.com

TABLET PCS

Make no mistake, tablet PCs are full-blown Windows XP computers. But as they trim down, they're becoming almost as easy to carry as PDAs. Consider the NEC Versa LitePad. At 2.2 pounds, this 0.6-inch-thick portable is compact enough to take anywhere. It has built-in 802.11a and b capability, so you can write that novel and surf the Web from any white sand beach.

NEC VERSA LITEPAD
$2,399
www.necsolutions-am.com

FUJITSU STYLISTIC ST4110 WIRELESS LAN
$2,299
www.fujitsupc.com

WI-FI CARDS

Every expansion slot is precious in a PDA or notebook. If speed is your thing, shop for a new 802.11g card. Or, if you want both storage and connectivity, go with SanDisk's Connect. It uses flash memory to stow files in Pocket PCs and Windows notebooks, and links you up to Wi-Fi networks.

SANDISK 128 MB CONNECT DUAL-FUNCTION CARD
$130
www.sandisk.com

LINKSYS WPC 54G WIRELESS G PC CARD
$70
www.linksys.com

VOICE OVER WI-FI

Clip one of these to your shirt and you can call a pal just by saying "Get me Jim." The sleek voice-activated badge uses Wi-Fi to link to a Vocera server, which connects you with another badge wearer, a cell user, or some poor schlub with a landline. This one-of-a-kind system is no toy: A network for 75 employees costs about $40,000 with PBX integration. So refrain from saying "Beam me up, Scotty!" unless you mean it.

VOCERA COMMUNICATIONS SYSTEM
$27,000 and up
www.vocera.com

bluetooth devices

LIKE WI-FI, Bluetooth uses the 2.4-GHz band for data transfer. But its maximum range is 30 feet, limiting it to gadget-to-gadget communication. There are more than 1,000 Bluetooth products on the market, with 10 more introduced each week.

PRINT ADAPTERS

Carry one of these gizmos around and you can hijack any printer. Say you're in a client's office. Connect the adapter to the printer's parallel port, turn on your Bluetooth-enabled PDA or notebook, and – bam – you're printing up a storm.

ANYCOM PM-2002 PRINTER MODULE
$149
www.anycom.com

3COM WIRELESS BLUETOOTH PRINTING KIT
$219
www.3com.com

TROY WIRELESS WINDCONNECT
$179
www.troygroup.com

GPS RECEIVERS

Lose the connector cables, not your way, when you hit the road. Socket's GPS receiver works quickly and cordlessly with laptops, tablets, and PDAs.

SOCKET BLUETOOTH GPS RECEIVER
$399
www.socketcom.com

HEADSETS

It's hard to look important while you're talking into a headset with that wire dangling in your face. Bluetooth headsets let you cut the cord and make calls even while your mobile is tucked away in your briefcase. But watch out: Some are so comfortable, you might forget to take it off.

JABRA FREESPEAK BLUETOOTH HEADSET
$99
www.jabra.com

ANYCOM BLUETOOTH WIREFREE HEADSET AHS-10
$79
www.anycom.com
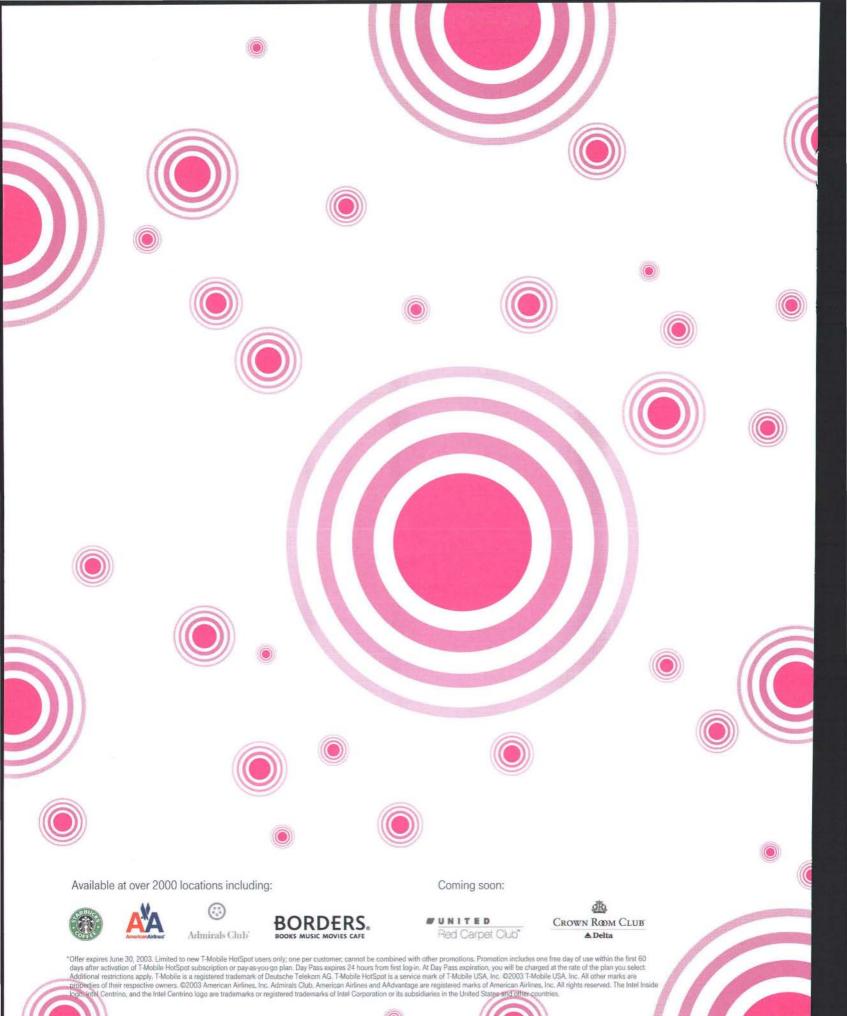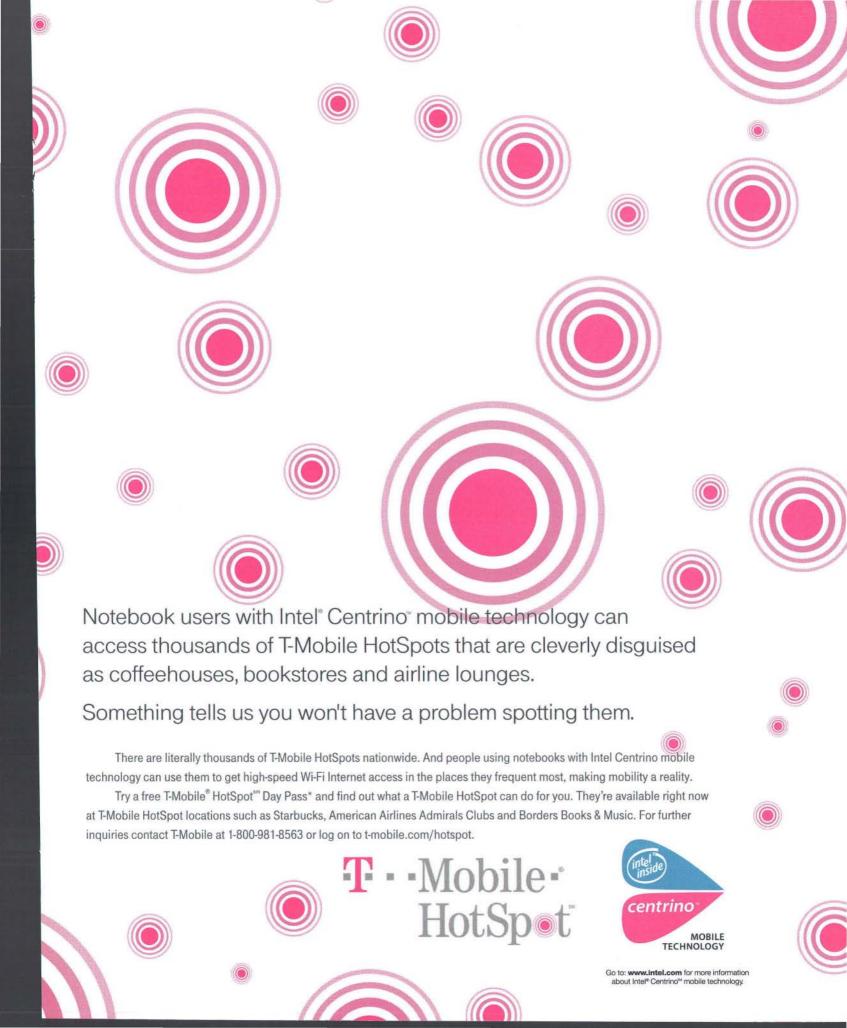
MOTOROLA BLUETOOTH WIRELESS HEADSET
$149
www.motorola.com

ACCESS POINTS

Power-efficient Bluetooth lets you link your devices to a network, and it won't eat up batteries as quickly as Wi-Fi. Caveat: The access point's price tag will chew through your wallet faster.

PICO PICOBLUE INTERNET ACCESS POINT
$419
www.pico.net
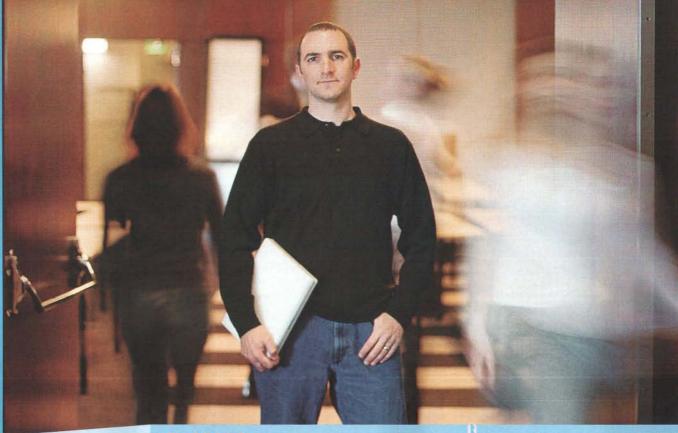
AXIS 9010 BLUETOOTH ACCESS POINT
$399
www.axis.com

Available at over 2000 locations including:

Coming soon:

STARBUCKS COFFEE

American Airlines

Admirals Club

BORDERS.
BOOKS MUSIC MOVIES CAFE

UNITED
Red Carpet Club

CROWN ROOM CLUB
Delta

Four stories from the wireless frontier.

At Conferences

Rael Dornfest
EMERGING TECHNOLOGY CONFERENCE CONVENTION CHAIR
O'Reilly & Associates • Portland, Oregon

It was clear Wi-Fi had transformed conferences when Qwest's then-CEO Joe Nacchio spoke at PC Forum in March 2002. Two audience members began to heckle in real-time blogs, and the crowd, reading along, turned against him.

I CHAIRED MY first wireless conference, the Peer to Peer, in January 2000. The first thing I noticed was that people weren't disappearing back to their rooms to check email between sessions. They'd just sit down in one of the common areas and log on. Because everyone was gathering in the same place, there was a lot more spontaneous discussion. Also, the sessions themselves became more interactive. Audience members would instant-message or email each other during a presentation as well as check out Web sites and info mentioned by the speakers. It really raised the quality of the presentations.

I remember at the 2002 Emerging Technology conference, Danny O'Brien set up a panopticon – a digital map of the conference layout with little icons representing attendees. You could move your icon to show what session you were attending, so that people could find you. But perhaps the most interesting wireless app is EtherPEG – code that scans the local network, captures a bit of every image being transmitted to and from laptops, and creates a montage of what people are looking at. At the Emerging Tech conference last year, someone posted the results to his weblog. When Larry Lessig was talking, the images went quiet. He's such an amazing speaker that people focused just on him. During other speakers, the images flowed like wine!
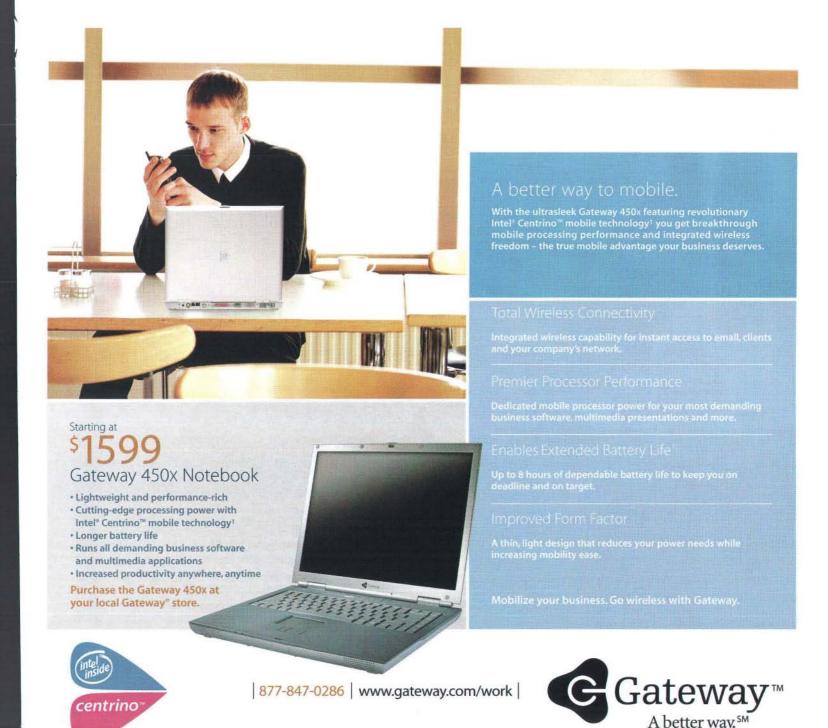
Remember Clay Shirky's idea of the lazy Web – that if you want something built, you just mention it on the Net and someone will build it? Mention an idea at a Wi-Fi conference – Steven Johnson's concept of Google Share, for instance – and within 48 hours there'll be three or four implementations of it.

You look good in wireless.

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With the ultrasleek Gateway 450x featuring revolutionary Intel® Centrino™ mobile technology[1] you get breakthrough mobile processing performance and integrated wireless freedom – the true mobile advantage your business deserves.

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Premier Processor Performance

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Enables Extended Battery Life

Up to 8 hours of dependable battery life to keep you on deadline and on target.

Improved Form Factor

A thin, light design that reduces your power needs while increasing mobility ease.

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Gateway 450x Notebook

- Lightweight and performance-rich
- Cutting-edge processing power with Intel® Centrino™ mobile technology[1]
- Longer battery life
- Runs all demanding business software and multimedia applications
- Increased productivity anywhere, anytime

Purchase the Gateway 450x at your local Gateway® store.

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centrino™

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G Gateway™
*A better way.*ᔆᴹ

Tony Thelen
MARKETING MANAGER
John Deere Ag Management Solutions • Urbandale, Iowa

Farmers who once just relied on gut instinct are now crunching numbers while working the field. High-end tractors, equipped with sensors, onboard computers, and GPS, are driven by data ranging from temperature to amount of seed released.
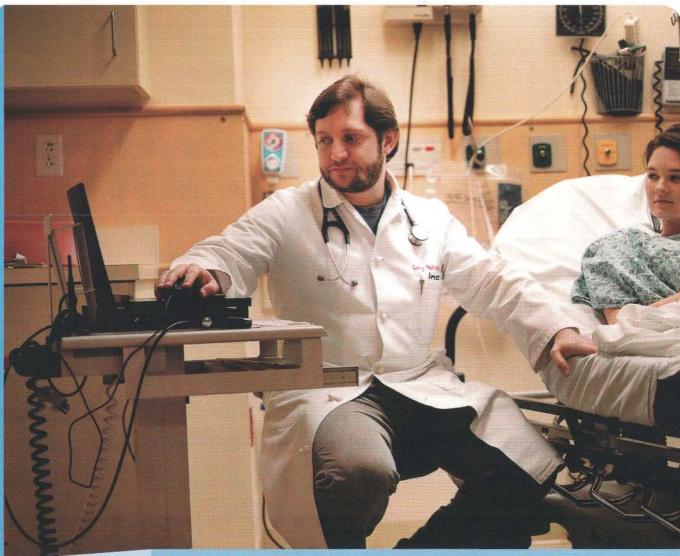
I GREW UP in Iowa, and you just don't typically think of *Star Wars*-type products in agriculture. So it was a shock for me when John Deere introduced its first wireless machine in 1996 – a combine that could measure the moisture of the crop and how much is harvested.

I was talking to a fellow the other day, and he said, 'I'll never buy that thing.' They think they don't need some whizbang satellite service. But you get them in the seat of the tractor, and after one trip down the field and back it's a done deal. At a basic level, they're less tired at the end of the day because AutoTrac uses differential GPS to determine the precise position of the tractor and then takes over the steering. Because the rows are more exact, the farmer isn't wasting seed or fertilizer by overlapping. One farmer told me he usually buys 11 percent more fertilizer and seed than he thinks he'll

need, just to account for spillage and overlap. This year, he used our ag-management system and ended up with only 9 percent more chemicals than he needed.

Low prices and imports are forcing farmers to be more efficient. Then there's the weather. Planting, cultivating, and harvesting windows are shrinking, and farmers have to be that much more efficient. Basically, you have good weather and bad weather, and when it's good you've got to be up and running. One farmer I met was planting 24 hours a day to take advantage of the good weather. He could work right through the night because of the satellite-controlled steering. We can steer tractors via the sky!

All that information is transmitted wirelessly and available 24 hours a day. If a machine breaks down, the system emails the service department.

JEFF SCIORTINO

MATT GUNTHER

In Hospitals

Larry Nathanson
DIRECTOR OF EMERGENCY MEDICINE INFORMATICS
Beth Israel Deaconess Medical Center • Boston, Massachusetts
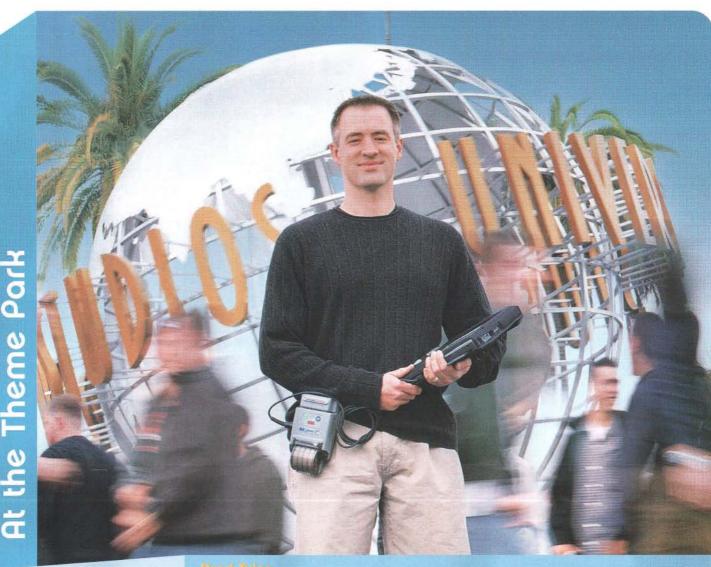
Hospitals use wireless to help tame their barely controlled chaos, though they can't always use off-the-shelf gear. Boston's Beth Israel developed its own low-power cellular network that doesn't interfere with medical equipment.

I CAN'T IMAGINE doing my job without wireless. We have wireless laptops for ER registration. That means we can start working on patients as soon as the medics wheel them in. It used to be that we'd have very limited background knowledge on a patient until that data had been entered into the dashboard system. Now we have all of the critical information immediately because the medics give it to an intake nurse sitting right there with us in the ER core.

The major win with wireless in the emergency department is the cell phone service. I was against it in the beginning. I didn't want to have to interrupt a conversation with a patient to take a call. But I found it actually improved patient/doctor relations. I used to be paged when I didn't answer my office phone. Even if the question was very simple, I would have to leave the patient's room and then invariably I would run into two or three other people who needed to talk to me and it would take me 20 minutes to get back to finish the conversation. Now the cell phone rings – it's a mobile hospital extension – and I answer the question right there in the room and hang up. It's an interruption, but only 10 seconds, and I end up spending a lot more time with patients. Plus, when patients can hear that it's a critical medical issue that's causing the interruption, they tend to be less angry. The nurses love it, too, because they know they can reach me in a second.

I was a programmer before I went to medical school. So I sit there in the emergency room and I think, 'Wouldn't it be great if … ?' Then I figure out how to do it. I'd love to do bedside electronic charting and order entry. That's my Holy Grail.

Brad Tyler
IT PROJECT MANAGER
Universal Studios • Hollywood, California

Where there are theme parks, there are lines. Universal Studios is helping to shorten the wait at the front gate using roaming ticket sellers armed with Wi-Fi-enabled devices and belt-mounted printers.

WE ROLLED out the wireless ticketing system on the Fourth of July, probably our highest attendance day of the year. I gave a unit to one ticket agent and took her out into the lobby. It was packed, and we quickly found our first customer. Within minutes, we had people getting out of line and crowding around us. I knew at that point that we were onto something.

It really changes the job. If you're waiting in the line, you're tired, you're hot, and you just want to buy your ticket and get inside as quickly as possible. But when the ticket seller is outside the gate, and you can just walk up to him, the interaction becomes more of a conversation. The sellers have essentially become hosts. On many occasions, I have seen guests planning out their day with the ticket seller, asking about the best time to visit Jurassic Park or the best place to get pizza.
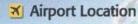
A lot of visitors aren't native English speakers. For them, the roaming ticket sellers have been great. When you're choosing from among 10 long lines, you have no idea who the seller is at the head of the queue. But our wireless sellers wear badges that identify them as bilingual.

Your first experience of the day is a lasting one. If you're waiting in line for half an hour and you're sweaty, that experience tends to stay with you. Any industry that deals with lines can apply this technology.

Desktop computer systems require the customer to wait in line – the data is anchored to the ground. Wireless allows you to go to the guest, rather than having the guest come to you. And wireless solutions are scalable: We can put 50 ticket sellers out there if we need to. The whole paradigm of waiting in long lines is gone. ■ ■ ■

good-bye 3G –
hello wi-fi frappuccino

BY
DAN BRIODY

Cellcos bet big on third-generation wireless – and took a big hit. Now T-Mobile's John Stanton has a grand convergence plan. Starbucks is just the beginning.

CASARRAMONA.CH

AS T-MOBILE USA'S John Stanton tells the story, his company's future was changed by a chance meeting with Michael Dell, chair and CEO of Dell Computer. During the 2001 Allen & Co. CEO schmoozefest in Sun Valley, Idaho, Stanton sat down for drinks on a sun-drenched patio and learned that Dell planned to build Wi-Fi into most of his company's laptops. It was a bombshell.

Stanton, chair of T-Mobile, had been spending much of his time discussing business trends with cell phone makers and network equipment providers, trying to figure out how to offer wireless broadband to mobile phone users. Like his peers in the cellular industry, Stanton thought Wi-Fi was just another open spectrum technology with no place to go – a fad like HomeRF and Bluetooth, a techno-hobbyist's Tinkertoy, a network for wireless weenies. The real solution to broadband wireless was 3G; it was just going to take a bit longer than expected.

But here was Dell with his plan to make devices that access the Internet wirelessly, and he's all about Wi-Fi. "Michael said they were going to build Wi-Fi into a significant portion of their laptops," recalls Stanton. "I was shocked. Up to that point, I thought [Wi-Fi] was nothing but more overstated expectations. But here was a guy that was deeply committed. It was at that point that I realized Wi-Fi was real. That was the seminal event."

The world of wireless communications has turned upside down. A few years ago, it was generally accepted that your phone would be your ticket to the wireless universe, and the cellular service providers, offering more and more services and bandwidth, would be at the center of the action.

The reality, as Stanton learned, is far different: Cellular was not cutting it. Its data and multimedia services were slow and ineffective. Computer makers wanted

a wireless broadband solution, and they wanted it right away. They wanted Wi-Fi.

Stanton came to this conclusion just as T-Mobile was embroiled in a fierce political and financial battle. The company was born a year earlier, when Deutsche Telekom announced it would spend an eye-popping $50 billion to acquire Voice-Stream, then the only US carrier with a network based entirely on GSM, the technology used widely by European carriers. Analysts immediately criticized the company for overpaying, and the acquisition (ultimately a mere $30 billion) coincided perfectly with the bursting of the Internet bubble, the cratering of tech valuations, and the beginning of a long, torturous decline in capital spending by wireless carriers. It was horrendous timing.

For a while, it seemed T-Mobile's salvation depended on 3G, the next generation of cellular technology, to revive the firm's dwindling revenue. Though there are many different paths to 3G (CDMA 2000, WCDMA, TDS-CDMA), the end result was to be the same: to make the Internet wireless, with a quantum leap in the capacity and speed of the networks. This was a pretty thrilling vision, so much so that the overheated European carriers got caught up in a bidding war for 3G spectrum licenses. Altogether, they ended up spending $100 billion just for the right to provide the service; the actual cost of building the networks and otherwise rolling out the technology would likely double that.

But the first trials of the favored European 3G standard, WCDMA, turned up troubling technical limitations, from disappointing data rates to high power consumption. And suddenly the massive debt that the carriers, including Deutsche Telekom, had taken on for the 3G landgrab started to look like a crippling mistake.

What this meant was that 3G was certainly not going to happen as planned, and might not happen at all. So T-Mobile settled on a

more modest path: It quietly began upgrading its GSM networks to a cheaper, more evolutionary technology called GPRS (also known as 2.5G) and waited for something to happen. Rumors abounded that T-Mobile was on the block. By the middle of 2001, even GPRS was labeled a major flop in Europe, with slow speeds and very little customer adoption.

Meanwhile, back in the US, T-Mobile watched as Sprint PCS and Verizon got their own 2.5G networks up and running using the competing CDMA standards, which were cheaper to deploy and offered faster speeds. The situation started looking desperate, with T-Mobile seeming to fall behind. But a revolution had been brewing, a movement to elevate a grassroots technology into a worldwide broadband solution.

Wi-Fi was an underdog from the outset. Built for data transmission across local-area networks with a radius of only about 150 feet, it was best suited to homes and corporate campuses. But in light of the 3G fiasco, it had some serious advantages: high speeds and low cost. Cellular carriers didn't know what to make of the new technology. Fear was the order of the day. "Wi-Fi was about the worst thing that could conceivably happen to them," says Richard Dineen, a wireless expert with London-based market research firm Ovum. "It was unlicensed spectrum with no barriers. Unsurprisingly, they kicked and screamed and didn't welcome its arrival." Some even talked about trying to kill Wi-Fi by complaining that unregulated wireless tech-

The longest known Wi-Fi transmission was sent nearly 200 miles from a weather balloon launched over Sweden.

nologies risked interfering with licensed spectrum and should be curtailed.

T-Mobile, however, was in too much trouble to waste time with tantrums. After his fateful meeting with Michael Dell, Stanton returned to the company's Bellevue, Washington, headquarters and set in motion a series of events that would radically alter Wi-Fi's fortunes – and, he hoped, T-Mobile's.

can't beat 'em join 'em moment. One by one, carriers – even ones that were betting big on 3G – began to recognize the promise of Wi-Fi. Sprint PCS invested in Wi-Fi service pioneer Boingo. AT&T announced a joint Wi-Fi venture with Intel and IBM called Cometa. While neither AT&T nor Sprint has announced plans to provide Wi-Fi service to their customers, that moment can't be far away. Even up-and-running 3G networks can't compare with Wi-Fi's speed and capacity.

Wi-Fi had fast become the thing carriers fear most: a disruptive technology. How disruptive? T-Mobile is now fiercely ambivalent about 3G as the future of wireless data. "We've always been an advocate and supportive of 3G, but frankly never saw a way to get it done in the US," explains Cole Brodman, senior vice president and chief development officer at T-Mobile and the man who hatched a business plan from

Intel and Qualcomm are experimenting with built-in Wi-Fi, and dual-action handsets are on their way. Samsung and HP have already shown PDA-based Wi-Fi phones; Motorola has promised one by the end of the year.

Though T-Mobile is the only carrier that has publicly disclosed plans to converge Wi-Fi with cellular, others are working on integrated networks. In February, at the 3GSM Congress in Cannes, Texas Instruments floated a scenario that includes cellular microbase stations combined with Wi-Fi hot spots to blanket dense urban environments.

In the meantime, T-Mobile is still tweaking its strategy. As the company evaluates various 3G technologies, the Starbucks Wi-Fi experience so far has been only a limited success, with reports of just 20 Wi-Fi users per day even in busy locations. To spur demand, in March T-Mobile slashed Wi-Fi

THE ULTIMATE GOAL: TO ROAM FREELY BETWEEN WI-FI AND CELLULAR NETWORKS – AND GET ONE BILL AT THE END OF THE MONTH.

Stanton heard that Starbucks, another Seattle-area company, was dissatisfied with the Wi-Fi network MobileStar was setting up for it, and he saw his opportunity. "MobileStar was defaulting on its obligations, and Starbucks was looking for another provider," says Stanton. "We reached an agreement. Starbucks terminated the MobileStar contract, MobileStar went bankrupt, and we bought them out of bankruptcy."

T-Mobile put $100 million behind its Wi-Fi initiative and began lighting up 2,000 hot spots in Starbucks stores around the country. In so doing, T-Mobile tipped the scales in the battle for next-generation wireless services. It was a classic if you

Stanton's enthusiasm. "We looked at Wi-Fi as a disruptive technology and a chance to get something done. On the 3G side, we are in the wait-and-see mode, and we are working on evaluating some other technologies."

The goal for T-Mobile and similar wireless providers is a seamless network, where one device hops from the Wi-Fi network to the cellular network with ease. Call it communications convergence: a blissful harmony of technologies, invisible to the consumer, that allows broadband access anywhere, anytime, from any device. Despite significant technical hurdles (not the least of which is a lightning-quick power drain), chipset makers like

access prices, and it's pushing ahead to unite its Wi-Fi and cellular networks. The ultimate goal: offering customers the ability to roam between the two and get one bill at the end of the month.

If T-Mobile gets it right, the company may soon have a customer base accustomed to using phones to move around big data and multimedia files. That's not far from the previous 3G vision – except for the 3G part, which T-Mobile barely mentions anymore. Wi-Fi, even in its young and developing form, has everything to do with that. ■ ■ ■

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Dewayne Hendricks
the ultrawideband cowboy
PEOPLE TO WATCH

Entrepreneur Dewayne Hendricks helped bring wireless broadband access to Mongolia, to Native American reservations, and most recently to isolated schools in Thailand. A member of the FCC's prestigious Technological Advisory Council, he says it's time to wrest control of the airwaves from the government. And he's looking beyond Wi-Fi to technologies like ultrawideband, cognitive (software-defined) radio, and dense-packet radio topologies that could soon make licensing unnecessary. Consider the benefits: wireless access for a nearly unlimited number of people, choreographed by smart software in their devices, not by Beltway bureaucrats. – Brent Hurtig

Investing in the Future of Wi-Fi

AM-BEO · bluesocket · Bluesoft Inc. · Broadreach Networks · Cometa · ECUTEL

INTERLINK NETWORKS · NOMADIX · pronto NETWORKS · red M · rovingIP.net

STSN · SyChip · TeleSym · transat INTEGRATING 3GSM & WLAN · VIVATO

Intel Capital, Intel's strategic investment program, is one of the largest worldwide corporate venture programs. Intel is investing in an ecosystem of companies with wireless programs focused on accelerating infrastructure deployment, removing barriers to adoption, developing innovative services, and harmonizing global technical standards. The investment in businesses developing Wi-Fi technology and services is another step in the effort to grow unwired mobile computing worldwide. To learn more about these companies, visit www.intel.com/capital.

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Yes. intel

palm pulls the plugs

BY
BRAD STONE

Free at last: A case study in learning to love
the unchained corporation of tomorrow.

IT WAS A SCENE to give any IT guy chills: 12 top executives of Palm Inc. were meeting in the boardroom last December. As usual, attendees had opened their laptops, unsheathed their PDAs, and were attempting to log on to the company's wireless local-area network before getting down to business.

But this time, the network wasn't working in half of the room. CEO Todd Bradley and his staff were getting nothing but sluggish connections and frustrating error messages. Mike Allison, director of the company's global tech infrastructure, quickly found himself on the receiving end of an angry phone call from his boss, CIO Marina Levinson. "I don't get yelled at that often," Allison recalls, "so there must have been some urgency."

Allison was ordered to diagnose and fix the problem immediately. But he could find nothing wrong with the company's network or the building's Wi-Fi nodes. Finally, he discovered that someone had set up a so-called rogue network – an unauthorized Wi-Fi hub – and it was crowding out the corporate LAN at the access point serving the executive conference room. The execs sitting around the table were inadvertently logging into the rogue node – a dead end.

With the help of a laptop and Kismet sniffer software, Allison identified the position of the rogue network. To his astonishment, its signal emanated from the office of Eric Benhamou, the chair of Palm and 3Com.

A pioneer of computer networking in Silicon Valley, Benhamou is also an Apple enthusiast and a lover of Wi-Fi. He had brought from home a Mac laptop and an Apple AirPort, which he had installed himself on the corporate intranet. Allison politely informed Benhamou that his home-brewed wireless network was, well, mucking up the works. Allison turned it off, and the Palm executive boardroom was once again bathed in glorious, empowering radio waves from a legitimate 802.11

access point. Connectivity was restored, and all was well.

In its Silicon Valley offices, Palm has one of the most sophisticated wireless networks anywhere. Eighteen Cisco Aeronet nodes cover 140,000 square feet across all three Palm buildings in Milpitas. Of the 700 employees on the campus, more than half have Wi-Fi cards. Palm also put in 30 Bluetooth access points throughout the offices to connect (albeit slowly) PDAs to the Internet.

Palm doesn't just want to unshackle its employees. The company needs to fully embrace a wireless workplace so it can road-test devices and stay on top of Wi-Fi trends. Even more important, it wants to remake itself into a dynamic illustration of a flourishing unplugged workplace, to help convince penny-pinching execs at other companies that it's worth bringing the technology to their offices as well.

Palm's future depends on it. Gone are the days of its first Pilot, when a portable digital calendar and phone directory were enough to persuade thousands to fork over $300. Those features are now commonplace in myriad devices. Today and for the conceivable future, the development of PDAs revolves around getting businesses to embrace wireless networking. Microsoft, Hewlett-Packard, Research in Motion, and a crowd of mobile-phone vendors in Asia and Europe are all elbowing their way into the market. Palm is on a mission to convince the world that it knows the business better than anyone.

For now, Palm's transformation is underwhelming. Employees are, as expected, working away from their desks. Outside headquarters, several sit tapping away at laptops, enjoying the Valley's warm sun. And in an empty conference room near the lobby, another employee, taking refuge from his cubicle, answers email. But most still work in their cubes, tethered to their Ethernet-hungry desktops and their voice-over-IP telephones – both of which are

anchored to cables that snake through the buildings' floors.

Unlike far-flung university campuses and factory floors, where mobile connectivity is often the only alternative, corporate America has yet to fully embrace wireless networks. CIOs are nervous about security vulnerabilities. Companies know they can never fully cut the tether so long as workers need docking and recharging stations. And many firms are simply too comfortable in their use of Ethernet, a technology that contractors routinely install in all new office buildings.

For now, the heart of Palm's wireless transformation is in that cherished universal experience: the meeting. One of the most popular software apps around the office is Colligo Meeting, which allows six PDA owners, sitting up to 30 feet apart, to instruct their devices to find the first mutually acceptable meeting time. Once connected, colleagues can volley instant messages – a real-time meta-conversation that underlies whatever's transpiring. Palm staffers also use a Bluetooth application called Blueboard to scrawl messages to each other on the screens of their PDAs.

The downside of all this connectivity is, of course, more intrusion into what was formerly known as free time. "It used to be that just the cell phone could get you. Now I'm available on every channel, every hour of the day, if I choose to be," says Eric Klein, a group manager.

It also means more goofing off. More than once, says Klein, he's been running a meeting and noticed a colleague's fingers

ILLUSTRATION BASED ON PHOTOGRAPH BY JEFF SCIORTINO

Doug Karl

the apple farmer   PEOPLE TO WATCH

Doug Karl invented the Apple AirPort, built the first device to translate Ethernet input into wireless output, and wrote access point software licensed to companies like Sony, Dell, and IBM. He is also founder and president of KarlNet, a growing Dublin, Ohio-based company whose flagship product is TurboCell – a supercharged protocol that can be "flashed" into inexpensive Wi-Fi gear, optimizing it for high-performance, long-range use outdoors. The improvement is especially useful in rural areas, where access points can provide entire communities with broadband. An answer to the last-mile problem? "It's more like the last 20 miles," he says. – Joseph Portera

feverishly pecking away at a laptop or PDA. "There's no way a human can reply to an email and appear to be paying attention," he says.

Larry Birenbaum, who oversees wireless strategy at Cisco, says fighting the distraction of always-on Net access during meetings is simply a matter of developing a new code of conduct governing its use. "Imagine the caveman days," he says. "They had some meeting, and all of a sudden, someone brings in a chisel and stone

themselves. To avoid getting caught, "we had to somehow camouflage [the antennas]," sysadmin Darryl Lee recalls. The solution: Lee punched holes in empty Palm V and VII boxes, placed the antennas inside, and scattered them around the building. He and his cohorts put up 12 hidden nodes around two buildings, typically in cubicles near conference rooms. "Only the telltale cable [running to the antennas] signaled anything unusual," he says.

Yet the network was insecure. In 2001, some computer scientists at UC Berkeley announced they had cracked WEP, the wireless encryption standard, which was the only thing protecting Wi-Fi-enabled networks. Palm employees recall being able to drive down Tasman Drive in San Jose and easily hop onto Cisco's nascent Wi-Fi network, called Tsunami. Although the Palm setup was similarly vulnerable, at least it was small enough to hide from

VIIs and upgrading their older models with the new Xircom attachments. And inside the office, workers preferred to connect via 802.11 rather than over sluggish wide area networks. Palm got the message: In August 2002, when the company moved to its Milpitas offices, Palm put in its current network of Wi-Fi and Bluetooth nodes. For security, these networks were placed outside the corporate firewall and safeguarded with a virtual private network that uses sophisticated encryption to keep away intruders. The experiment to prove that going wireless is worth it had officially begun.

When the first corporation pulls the plug entirely, "workers will become totally unchained," says Kenneth Berger, founder of San Francisco-based consultancy LogX Technologies. "Corporate culture will be changed in ways we can't fully understand." Employees will be free to roam anywhere

TO CAMOUFLAGE THEIR SECRET WI-FI NETWORK, ENGINEERS HID ANTENNAS INSIDE EMPTY PALM BOXES AND STASHED THE NODES IN CUBICLES.

to take notes. That must have been equally distracting. Over time, you get used to it."

Neither Palm nor Cisco thinks this is enough of a problem to restrict when employees can use computers or handhelds. But other Valley companies, like Wi-Fi hardware maker Proxim, ban laptops and other connected devices from some high-level powwows. "Just like the mobile phone, you have to set limits," says Proxim exec Maureen Smith.

Palm's wireless culture started, as always, with the nerds. In late 2000, when the company still operated from the campus of its former parent, 3Com, the engineering group tired of trying to get the old-school IT department to adopt the new 802.11b technology. So they decided to set up a network
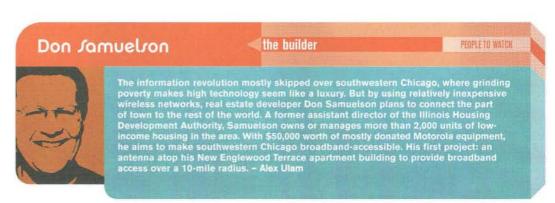
most such war-driving detections. And if the nerds' endeavor had risked exposing Palm's corporate LAN to hackers (for a short time), it was worth it. The outlaw experiment gave Palm a compelling glimpse into the future.

At the time, the company was betting big on the Palm VII, which could download email and calendar appointments over the Mobitext pager network. But just as word of Palm's Wi-Fi network spread from one employee to another, Intel subsidiary Xircom announced its first 802.11 "sled." Attached to a Palm m500 or 505, the sled let users surf the Net over Wi-Fi and get email hundreds of times faster than they could with the Palm VII. Soon, employees were discarding their Palm

they're needed. Conferences will take place spontaneously, no matter where the participants are. Phones may look like Star Trek badges pinned to clothes.

When Palm goes totally wireless, it will be an ironic moment in Silicon Valley history. Palm was, after all, bought and later made independent by 3Com, which was founded by Bob Metcalfe in 1979 to capitalize on his invention of Ethernet. Twenty-four years later, 3Com's protégé may help to make the wired network obsolete. ■ ■ ■

Brad Stone (bstone@gearheadsthebook.com), a Silicon Valley correspondent for Newsweek, is the author of Gearheads: The Turbulent Rise of Robotic Sports.

Don Samuelson   the builder   PEOPLE TO WATCH

The information revolution mostly skipped over southwestern Chicago, where grinding poverty makes high technology seem like a luxury. But by using relatively inexpensive wireless networks, real estate developer Don Samuelson plans to connect the part of town to the rest of the world. A former assistant director of the Illinois Housing Development Authority, Samuelson owns or manages more than 2,000 units of low-income housing in the area. With $50,000 worth of mostly donated Motorola equipment, he aims to make southwestern Chicago broadband-accessible. His first project: an antenna atop his New Englebard Terrace apartment building to provide broadband access over a 10-mile radius. – Alex Ulam

20,000 nodes or bust!

BY
LUCAS GRAVES

Everybody talks about the Wi-Fi future. Cometa CEO Larry Brilliant is building it — with some help from three little outfits called IBM, Intel, and AT&T.

THREE YEARS AGO, while at the helm of the now-defunct Aerzone, Larry Brilliant burned through almost $100 million trying to construct a Wi-Fi network for the country's airports. At the end of 2000, he gave up, citing lack of demand. But things have since changed a great deal in the unwired world, and now Brilliant's back with a far more ambitious plan. As the head of Cometa Networks, he intends to build a 20,000-node nationwide Wi-Fi network – before 2007 is out.

"Simply put, we will be the biggest provider of wholesale 802.11 bandwidth in the United States," Brilliant says from the company's San Francisco headquarters. "No place in the top 50 metro areas will be more than five minutes from an access point."

Cometa seemed to appear out of nowhere last December. Backed by AT&T, Intel, and IBM, the outfit had been percolating quietly under the code name Project Rainbow for the better part of a year. Its partners dropped $1 million to study the potential market for Wi-Fi and develop a business plan. "We spent nine months locked in a room with 40 full-time professionals," says Brilliant, who is Cometa's acting CEO until he can find someone to run things day-to-day. "There's hardly anyone in wireless we didn't talk to – and because of the companies involved, they all called us back."

Members of the research team knew they could count on PC manufacturers to begin including 802.11 gear as standard equipment in their new notebooks, which would jump-start demand. They also found that corporations were beginning to embrace the technology. The question was where to position Cometa. It needed to find users who would pay for access.

Cometa's plan calls for AT&T to build and operate the network, helping defray the massive infrastructure costs. IBM will handle backend billing systems, and Intel will provide capital as part of its pledge to invest $150 million in promising Wi-Fi ventures around the world. Additionally, Cometa will avoid the enormous cost of building a brand by acting exclusively as a wholesaler. It will supply bandwidth to service providers who in turn will act as resellers.

To the technology partners, the reasons to be involved with Cometa are obvious. Intel's Wi-Fi chipsets get a boost in demand. AT&T adds another flavor of network to its menu, and IBM's Global Services arm gets to turn its corporate clients on to a whole new technology.

Of course, even with Cometa's blue-chip backers, there's no guarantee that the plan will work. There's been a conspicuous lack of interest in paid Wi-Fi service so far. Underwhelming demand has already claimed at least three early Wi-Fi service providers, and others – Boingo and Wayport – have run into similar trouble building their subscriber base. T-Mobile runs the biggest subscription 802.11 network anywhere, with more than 2,000 nodes around the country, mostly in Starbucks cafés.

But like T-Mobile, some of Cometa's stiffest competition comes from the free networks popping up like daisies after a spring rain. Public Wi-Fi experiments in cities from Barcelona to Long Beach have shown that it can cost just a few thousand dollars to set up a free network.

As independent tech vendors emerge with security solutions for these free networks, Cometa could have a hard time convincing anyone they should pay for access.

Yet these issues don't concern Brilliant nearly as much as the company's core challenge: a massive landgrab. The b-school mantra that fast-food chains are actually in the real estate business applies to Cometa also; success depends on properly locating access points. And it has to be everywhere before it can sell anywhere. "We can't say we're in 60 percent of Hyatts. We have to say we're in all of them," Brilliant explains of his effort to recruit resellers. "No one's going to buy a nationwide, all-you-can-eat model before you've got 20,000 nodes."

More than 90 percent of the Wi-Fi nodes in Manhattan are below 96th Street.

One of the most interesting aspects of Cometa's strategy is its target market – not executives jetting from JFK to SFO, but "windshield warriors," the insurance and pharmaceutical salespeople who roam their districts in wrinkled suits and midsize sedans. Researchers say the market for "mobile field sales applications and services" will grow eightfold, to $1 billion, over the next four years.

With secure network access from a parking lot or even a gas station, these salespeople could use time between meetings to catch up on email, file reports, and update accounts – meaning more sales calls and fewer hours in front of the computer once they get home. "Windshield warriors don't go to hotels or to airports, they go to McDonald's," says Dean Douglas, an IBM vice president who has worked for Cometa from its inception. "They have a lot of dead time, but they're not in a place where they can immediately go and do some work." And so, naturally, Cometa plans to roll out hot spots under the golden arches, too.

After his Aerzone failure, Brilliant naturally wants Cometa to be a great commercial success. But if not, the company can count victory by achieving its backers' main aims: creating a critical mass of hot spots, making public Wi-Fi practical, and driving mainstream consumer demand. That's great for Cometa's partners, but it would also thrill other companies across the technology industry, making Wi-Fi the next big thing Silicon Valley so desperately needs. ■ ■ ■

Lucas Graves (lucasgrv@yahoo.com) *is a freelance writer living in New York City.*

David Reed

the visionary　　PEOPLE TO WATCH
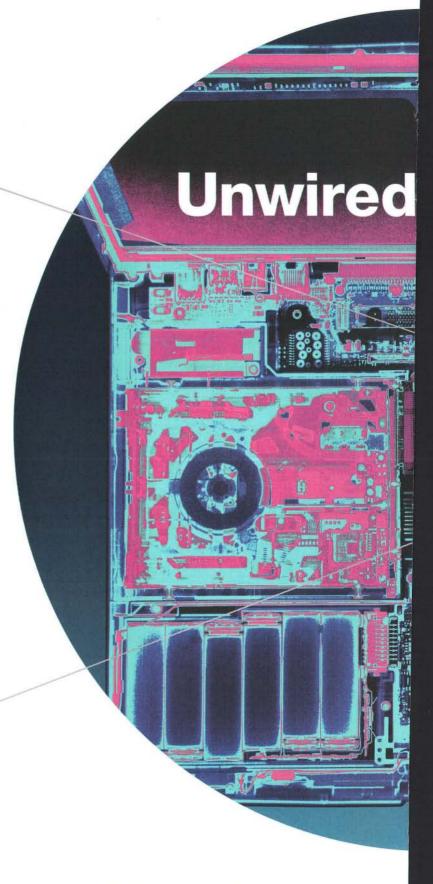
In David Reed's perfect world, there'd be no cell phone towers. The MIT Media Lab adjunct professor envisions wireless devices communicating with one another, acting like tiny transmitters. Wireless spectrum, he says, is "the ultimate renewable resource," and because radio signals are made of photons that can pass through each other, it's also "expandable and scalable without bound." Reed and fellow researcher Andy Lippman founded the Viral Communications project to explore how cooperating devices could one day make cellular carriers, cable companies, and ISPs obsolete. "We expect everything to be able to connect to everything else," says Reed, who also helped develop the original Internet protocols. "And we don't want to pay a monthly fee for each device."
– Mark Frauenfelder
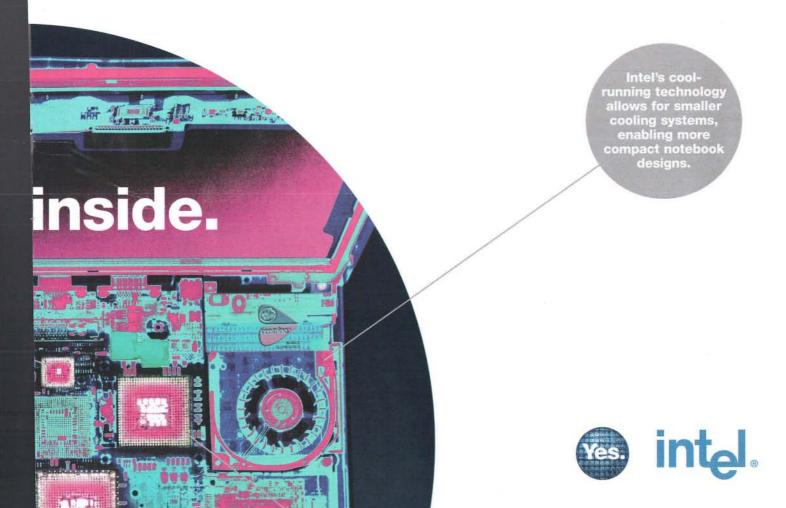
Intel's built-in 802.11b wireless LAN capability eliminates the need for adapter cards.

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Intel's technology packs outstanding performance into a thinner, lighter form.

beyond wi-fi

BY
XENI JARDIN

The 5 next big things.

ULTRAWIDEBAND
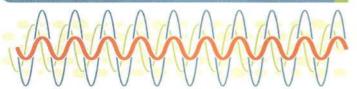
This superfast, short distance wireless technology promises data speeds 10 times faster than Wi-Fi. It works by transmitting its signal over a wide swath of frequencies, including licensed bands, at such a low power that it doesn't interfere with the other occupants of the spectrum.

That's the idea, anyway. In February 2002, the FCC approved UWB for short-range applications despite howls of protest from the FAA and wireless carriers like Verizon and Sprint. Early tests by NASA, among others, raised questions about potential interference with airplane collision-avoidance systems and existing wireless networks. The FCC ruling allows development to proceed while these questions get addressed.

If it works, UWB could give rise to a new generation of portable and home entertainment products. Digital video, audio, or television streams could be managed with UWB quality equal to a hardwired system, and its high speed and low power consumption make it perfect for home networking. First-generation UWB products are expected in late 2003, but it could be five more years before UWB is widely adopted.
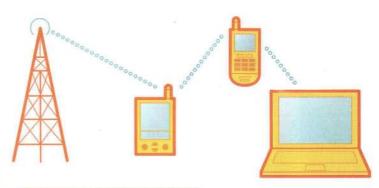
SOFTWARE-DEFINED RADIO

Just as remote controls proliferate in our living rooms, our lives are filling with incompatible wireless devices, from cell phones to baby monitors. Even if they have very different functions, these gadgets share many of the same basic technologies: transmitters and receivers, batteries and antennas. Universal remotes exist; why not universal wireless devices?

That's the inspiration for the growing software-defined radio movement. Rather than determine a wireless device's function with dedicated hardware, gadget makers can keep the electronics to a bare minimum of generic radio chips and control them with software, which can morph endlessly. Think of the difference between a PC and a cash register: Both may be computers, but one is a general-purpose device whose function is defined by software and can be changed at will, while the other is hardwired for a single task.

Software-defined radios can reconfigure themselves automatically to recognize and communicate with each other. This could impose order on the current Babel-like chaos of competing wireless standards (CDMA, GSM, TDMA, and countless others), transforming today's rigid networks into nimble, open systems. The big payoff: improved system performance, cheaper service cost, and seamless roaming. With instant reprogramming, you can carry a single gadget for multiple uses. A cell phone becomes a garage door opener, which morphs into a mobile gaming device, which then – presto! – turns itself into a TV remote. But none of this will happen overnight. The key digital signal processor chip is still under development. Watch for new Intel CPUs to include a type of software-defined radio that will likely be able to adapt to different wireless LAN standards. If all goes well, software-defined radio will make its way into cell phones and other mobile units by 2008.

MESH NETWORKS

One of the most highly anticipated technologies, mesh networking turns nearly any wireless device into a router, creating an ad hoc network. Members of a network no longer rely on a central routing hub to distribute data – instead, the information hops from one user's gadget to another until it gets where it's going. Each connected cell phone, PDA, or laptop pitches in a little routing power, forming a spontaneous, temporary wireless cooperative. The advantages include cheaper service and wider coverage areas. Plus, proponents claim mesh can send data at speeds above 6 Mbps – about 15 times faster than DSL. Using higher bandwidth protocols like UWB, those speeds could reach 500 Mbps. But there are challenges: How will data remain secure as it passes from device to device before reaching its destination? How can participants be billed for connectivity? And dynamic routing can be complex; these systems slow to a crawl if traffic is poorly managed.

WIRELESS PERSONAL AREA NETWORKS

This short-range technology lets everyone have their own little local wireless network. Within a personal bubble of operating space, PCs, PDAs, mobile phones, and digital music players detect one another and interact. Defined by the Institute of Electrical and Electronic Engineers as a zone of at least 10 meters (32.81 feet) around a person, WPANs could forever eliminate snarls of cable and wire that booby-trap homes and offices. In their place: wearable, smart computing devices that converse on the fly, as well as new mobile digital payment systems and personal security technologies.

Devices within a WPAN create a flow of machine-to-machine communication that personalizes services spontaneously. But managing device interoperability, maintaining always-on connectivity between machines, and ensuring that personal information stays safely inside users' bubbles won't be easy. General Atomics, IBM, and Philips are among the tech titans said to be exploring WPANs. Watch for these networks to proliferate within two to five years.

ADAPTIVE RADIO

It's only polite to listen before speaking so as not to interrupt, but that's something radio is still learning. Adaptive radio is a move in this direction: a technology that lets wireless devices scout out the spectrum wherever they are, avoiding interference by tuning their transmissions to the available gaps. Such devices can modify their power, frequencies, or timing to suit the environment they find themselves in, making such adjustments at occasional intervals or constantly checking and changing as airwave traffic shifts around them. Some also rely on smart antennas that use phased-array technology to aim their transmissions at the receiver, rather than broadcasting in all directions like most antennas.

Unwire the world.

The company that helped wire the world is driving the effort to unwire it. Intel is bringing together leading service providers, technology manufacturers and various retail locations, including hotels, airports and cafés, to make wireless access universal. Today there are thousands of wireless hotspots worldwide. Together, we are working to make the wireless experience as common as, let's say, a cup of coffee.

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25 companies to watch

BY PAUL BOUTIN
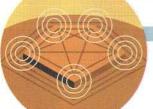
As the Wi-Fi industry evolves from a handful of hot spots into a full network, it is splitting into four sectors: service providers that operate networks; software firms whose apps tweak the usefulness of Wi-Fi or manage networks; hardware that connects you to the network; and chipsets at the core of the hardware.

SERVICE PROVIDERS

Independent Wi-Fi providers, like early ISPs, face competition and consolidation as telecom firms enter the fray. Cellular carriers and Baby Bells have mostly avoided the scene: Compared with cell phone systems, Wi-Fi suffers from limited range and a puny market. It makes sense for the big boys to wait until smaller providers grow the market, then swoop in and take over. It won't happen this year, or next, but it's coming.
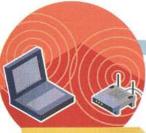
COMPANY	CEO	OWNERSHIP	PARTNERS	SERVICE	WIRED OUTLOOK
AT&T WIRELESS SERVICES Redmond, Washington	John Zeglis	NYSE: AWE	Wayport	Cellular, corporate wireless, Wi-Fi data	AT&T's still-growing wireless division isn't waiting around for Cometa. Instead, it's pushing its own GoPort service at airports and hotels. But availability is still limited to five airports and a few hundred hotels.
BOINGO WIRELESS Santa Monica, California	Sky Dayton	Private	Airpath, NetNearU, Surf and Sip, Wayport	National Wi-Fi network	Dayton's strategy worked for EarthLink: Let others set up the networks, then place a single brand name and billing system atop them. But investor Sprint PCS may want its name on the marquee.
COMETA NETWORKS San Francisco, California	Lawrence Brilliant	Private	AT&T, IBM, Intel	Wholesale national Wi-Fi network	This high-profile venture aims to build the infrastructure for mainstream Wi-Fi services. If it works, everyone will benefit, from consumers to other tech firms.
IPASS Redwood Shores, California	Ken Denman	Private, has filed for IPO	Cometa, Wayport	Remote access	Wi-Fi is just part of the roaming-access package iPass provides to business road warriors. By ignoring the consumer market, it has established enough market share to compete against telecom firms looking to offer Wi-Fi.
SURF AND SIP San Francisco, California	Rick Ehrlinspiel	Private	Boingo	National Wi-Fi network	The best, but probably the last, of the independents. This five-person firm operates 350-plus hot spots in small businesses in the US and UK, but much bigger players will soon be courting its customers.
T-MOBILE USA Bellevue, Washington	No CEO. John Stanton, board chair; Robert Dotson, president and COO	T-Mobile International, a subsidiary of Deutsche Telekom AG; NYSE: DT	Starbucks	Cellular, Wi-Fi network	Formerly VoiceStream, the American arm of DT operates networks at more than 2,100 Starbucks. This high-visibility service places T-Mobile ahead of the competition.
WAYPORT Austin, Texas	Dave Vucina	Private	AT&T Wireless, Dell, Intel, iPass	High-speed fixed line and wireless Net access in hotels and airports	Wayport operates hundreds of hot spots in prime locations like Sea-Tac airport and the Four Seasons. But how will it fare against lurking wireless giants?

SOFTWARE COMPANIES

Wi-Fi is attracting a wave of software innovators whose wares could disrupt the market by letting home and business networkers do without big-ticket hardware or service contracts.

COMPANY	CEO	OWNERSHIP	PRODUCT	WIRED OUTLOOK
MESHNETWORKS Maitland, Florida	Richard Licursi	Private	Software to extend wireless LANs	MeshNetworks' software lets wireless laptops double as base stations for others, extending a network's reach. This is a disruptive technology, which could provide a radical alternative to long-range cell phone networks.
PRONTO NETWORKS Pleasanton, California	Jasbir Singh	Private	Hot spot management software	Backed by $5 million from Intel and DFJ, the company's wireless ISP management and billing software is becoming the choice of midsize players positioning for easy buyout in the coming consolidation.
TELESYM Bellevue, Washington	Raju Gulabani	Private	Voice-over-IP software	Intel's investment raises the likelihood the company's wares will be bundled with laptops and PDAs as a cell phone alternative. Biggest threat: Microsoft could add a similar app to Windows.
TREPIA Fremont, California	Jawed Karim	Private	Software that creates a buddy list of other wireless users nearby	A great application (why doesn't my phone do this?), but like AIM or Napster, it will need big investment dollars to reach a critical mass of customers. Acquisition by a major service provider seems likely.

XPLANE

HARDWARE MAKERS

This sector will soon be a battle between scrappy gear makers and entrenched equipment makers. First-mover companies include those that manufacture or resell base stations, client cards, and Wi-Fi-ready devices. Look for notebook leaders like Dell to also offer client cards and quietly steal the market. Still, with so many laptops and desktop PCs already in use, demand for base stations and clients will only go up.

COMPANY	CEO	OWNERSHIP	PARTNERS	WIRED OUTLOOK
APPLE COMPUTER Cupertino, California	Steve Jobs	Nasdaq: AAPL	N/A	By renaming it AirPort and hiding the antennas, Apple made 802.11b a household word. But PC makers have since caught up, and they're competing on price.
CISCO SYSTEMS San Jose, California	John Chambers	Nasdaq: CSCO	Atheros, Intel, HP	The network hardware colossus recently began providing free security and range-extending software to makers of most Wi-Fi chipsets, ensuring demand for its access points and other backend equipment.
DELL COMPUTER Round Rock, Texas	Michael Dell	Nasdaq: DELL	N/A	Michael Dell has sent a message to the market: Dude, you're getting Wi-Fi. Built-in Intel chipsets on all notebooks could undermine the premium positioning of add-on cards.
D-LINK Taipei, Taiwan	Ken Kao	TWSE: 2332.tw	N/A	D-Link or Linksys? It's a common question. The company's challenge is to differentiate its products.
LINKSYS GROUP Irvine, California	Victor Tsao	Private	Net2Phone	The Honda of hardware: fast-growing, cheap, utilitarian. New products to extend existing networks add extra sales per customer.
MICROSOFT Redmond, Washington	Steven Ballmer	Nasdaq: MSFT	Intersil	Software makers, stay home: Wi-Fi is the next thing to be absorbed into Windows. The company already resells base stations and other hardware that feature user-friendly encryption.
NETGEAR Santa Clara, California	Patrick Lo	Private	Net2Phone, Philips	Rival to Linksys and D-Link, Netgear is the third name in do-it-yourself networking's Big Three. The company's formula is simple: Make good stuff cheap. Private status may prove an advantage if tech stocks keep falling.
PROXIM CORPORATION Sunnyvale, California	Jonathan Zakin	Nasdaq: PROX	Avaya, Digital China Holdings, Motorola	The acquisition of Lucent's Agere spinoff, along with its popular Orinoco cards, consolidated Proxim's brand strength but added to last year's $240 million loss.
VIVATO San Francisco, California	Ken Biba	Private	N/A	This new kid on the block has a smart antenna that reaches out to find users hundreds of feet away. If it works, it could become standard for big installations.

CHIPSET MANUFACTURERS

Wi-Fi is one of a few bright spots in the moribund semiconductor industry. The companies that build the radio hardware to go into other firms' base stations, access cards, and computers are supplying the wireless equivalent of a cable jack. However, this demand is already spurring consolidation. Watch as giant chipmakers like Intel integrate 802.11 circuits onto motherboards, removing the need for a separate wireless chipset.

COMPANY	CEO	OWNERSHIP	CUSTOMERS	WIRED OUTLOOK
ATHEROS COMMUNICATIONS Sunnyvale, California	Rick Redelfs	Private	D-Link, HP, Linksys, Netgear, Philips, Proxim, SMC, Sony	Four of the top five notebook sellers build in Atheros' dual-band 802.11a/b chipset, and the company is at work on a new product that will also meet demand for the emerging 802.11g standard.
BROADCOM CORPORATION Irvine, California	Alan Ross (interim)	Nasdaq: BRCM	Cisco, Dell, HP, IBM, Motorola	Broadcom's 54g chipset is poised for success, even before 802.11g is final. Linksys, Belkin, AMD, and others have pledged to use or support it.
INTEL Santa Clara, California	Craig Barrett	Nasdaq: INTC	Dell, HP, Sony	Intel is the 800-megaton gorilla in this market. Makers of dedicated Wi-Fi chipsets stand to lose big as the company incorporates Wi-Fi into its motherboard components.
INTERSIL CORPORATION Milpitas, California	Rich Beyer	Nasdaq: ISIL	Cisco, IBM, Nokia, Sony	Intersil's Prism2 is pretty much the industry standard. The company's only real threat is a big one: Intel and other CPU makers want to eliminate the need for a separate Wi-Fi chipset.
TEXAS INSTRUMENTS Dallas, Texas	Thomas Engibous	NYSE: TXN	D-Link, US Robotics	TI's proposal for 802.11g was rejected, setting back plans to dominate next-gen wireless networking chipsets.

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▶ MONTHLY AIRTIME CHARGES

Service	Charge
Deluxe Voice Service (includes satellite and landline)	39.99
Mobile Email	5.99
Mobile Internet Connectivity	5.99
Television Entertainment Package	49.99
Home Alarm System (with invisible fence option)	29.99
Monthly Airtime Charges Subtotal	131.94

1,445.34

1,577.28

▶ PREMIUM SERVICES CHARGES

Itemized breakdown on pages 2-11.   141.96

Subtotal

TOTAL ▶ 1,719.24

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*Includes use of two multifunction LG Siemens handsets

PREMIUM SERVICES

Date / Time	Location	Activity	Pricing Plan	Charge
1 Apr 7:32	Home	Key retrieval	Tier 1	0.00
1 Apr 7:38	Deerfield, IL	Traffic dwnld	Tier 1	0.00
1 Apr 8:13	Edens Expwy	Toll	External	9.00
1 Apr 8:15	Skokie, IL	Traffic dwnld	Tier 1	9.99
1 Apr 8:16	Edens Expwy	Music dwnld: Eminem: Greatest Hits	Tier 2	8.00
1 Apr 8:36	Chicago, IL	Traffic zone fee	External	6.00
1 Apr 9:08	Chicago, IL	Parking	External	3.00
1 Apr 9:35	Chicago, IL	Horoscope dwnld	Tier 2	30.00
1 Apr 15:47	Chicago, IL	Conferencing services/4 parties	Tier 3	0.00
1 Apr 18:34	Edens Expwy	Traffic dwnld	Tier 1	14.00
1 Apr 19:00	Northbrook, IL	Toll	External	4.50
1 Apr 19:01	Home	Video dwnld: Fox News	Tier 2	3.20
1 Apr 20:30	Home	Ebook dwnld: Infinite Jest Chap 250-500	Tier 2	3.20
1 Apr 21:02	Home	Ebook dwnld: Infinite Jest Chap 501-750	Tier 2	12.00
1 Apr 22:23	Home	Film dwnld: The Remains of the Day	Tier 2	100.00
1 Apr 23:00	Deerfield, IL	Premier dwnld: WWE Royal Rumble 2006	Tier 3	0.00
2 Apr 6:45	Kennedy Expwy	Traffic dwnld	Tier 1	7.00
2 Apr 6:57	ORD Airport	Toll	External	23.00
2 Apr 7:33	ORD Airport	Parking fee: 1 day	External	2.10
2 Apr 7:59	ORD Airport	Vending machine: 6 oz Red Bull AM	External	5.00
2 Apr 8:03	American United	Game dwnld: Vice City IV	Tier 2	20.00
2 Apr 8:45	American United	In-flight Wi-Fi	Tier 2	3.00
2 Apr 11:32		Misc: salted peanuts	External	

PG. 2/13

PG. 3/13

PHOTOGRAPH: MORTEN KETTEL; ILLUSTRATION: RYAN VULK

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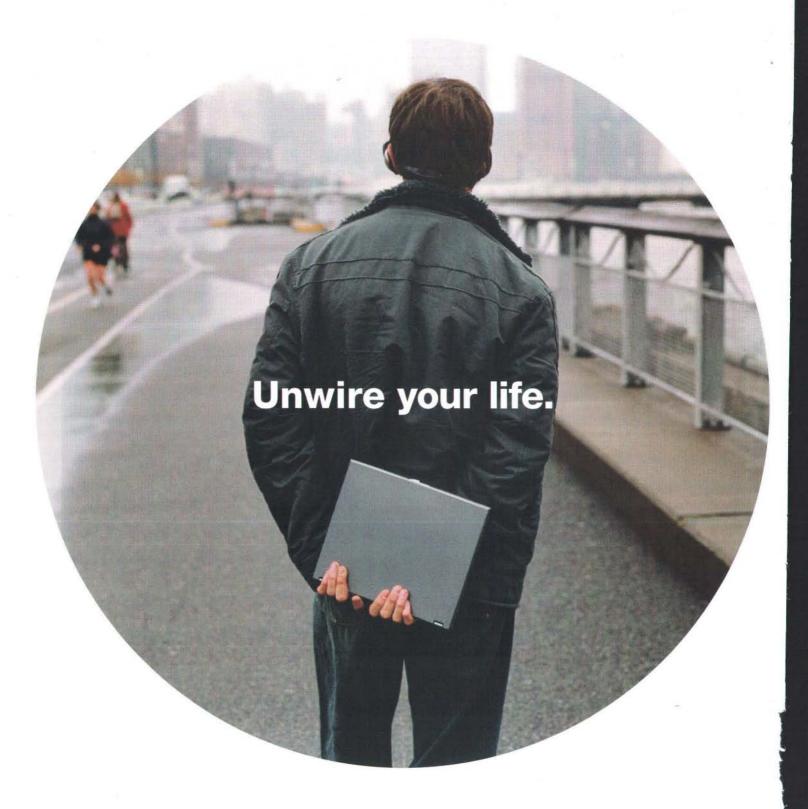
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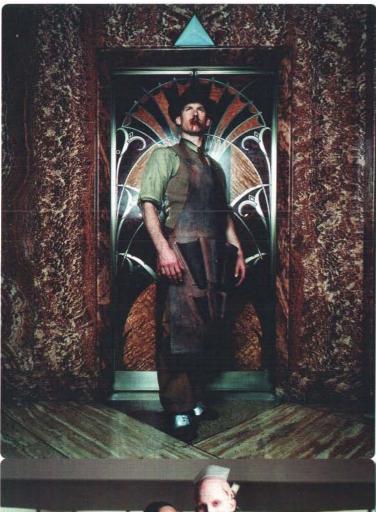
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Cremaster of His Domain

What do you get when you cross a prosthetic mutant with the Chrysler Building, a few Rockette wannabes, and a giant with a particularly bad case of psoriasis? The hallucinatory landscape of *Cremaster 3*, the final film in Matthew Barney's pentalogy, starring among others the director himself, Paralympic athlete Aimee Mullins, and artist Richard Serra (pictured counterclockwise from top). Showing at NYC's Film Forum through May 7 before rolling out nationwide, this esoteric picture crunches material from such a dizzying array of sources — architectural theory, Freemasonry, biochemistry, psychosexuality, and Mormon law — it's like trying to cram the *Encyclopaedia Galactica* into a little more than three hours. Yet, while *Cremaster* may be difficult to parse, it's not impenetrable. Viewers with patience and an open mind will find that Barney's symbolic matrix offers an eloquent expression of our most basic human fears and desires. Shot entirely in the highest of high-definition video, 24P, and featuring the stunning talents of former ILM f/x whiz Matthew Wallin, these films are gorgeous. Those who aren't disgusted will be enthralled. – **Todd Wagner**

MATTHEW BARNEY BRINGS HIS HIGHBROW CREEP SHOW TO A CLIMAX

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LINCOLN

The End of Human Nature

Bill McKibben bravely explains why designer babies are a very bad thing. reviewed by David Gelernter

STAYING HUMAN IN AN
ENGINEERED AGE

Enough

BILL
McKIBBEN

Author of The End of Nature

To the new wave of genetic scientists, Coleridge's ancient mariner – who preached love and respect for the natural world – is more than just old. He's obsolete. Why should you bother loving nature off-the-shelf if you have the power to make it better? We're headed toward an era when human beings will be as casually "enhanced" as chickens or marigolds, with higher IQs, better looks, longer lives.

Bill McKibben understands genetics – but he knows poetry, too. In his brave and luminous book, *Enough: Staying Human in an Engineered Age* (Times/Holt, $25), McKibben plays the part of the mariner, forecasting a frightening catastrophe brought on by human obliviousness. *Enough* indicts germline technology, the so-called designer baby science that aims to let parents improve their offspring by pasting desirable genes into their kid's DNA. What's so bad about that? McKibben explains: By ordering up athletics-enhanced, music-enhanced, optimism-enhanced children, you are not merely urging them in some direction – all parents do that; you are wiring your own tastes into their genes, literally twisting their minds and bodies into the shape you have chosen. And this staggering arrogance is bound to be futile because the technology will get better over time. If you upgrade your child with 25 bonus IQ points, you can count on a 50-point boost becoming available by the time your children have kids of their own. You've just made Junior obsolete. "The vision of one's child as a nearly useless copy of Windows 95 should make parents fight like hell to make sure we never get started down this path," McKibben writes. We've been taught that scientists are smarter than other people. But by counting on them to act wisely on our behalf, McKibben argues, we will be complicit: coconspirators in a gigantic (and maybe irrevocable) crime against humanity.

Behind this bizarre and terrifying project is control lust and naked nihilism. "The reason the techno-topians can talk so casually about the 'posthuman' future," McKibben writes, "is that they find nothing particularly significant about the human present." Scientists and technologists in general are not McKibben's enemies. Many (in my experience) are as horrified as he is by enhancement. Most are probably indifferent. But the cheerleaders are not a pretty sight. Someone asks His Eminence James Watson, co-unraveler of DNA, whether "enhancement" isn't a lot like eugenics, the weeding out of genetically inferior

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human stock. "It's not much fun being around dumb people," Watson answers. Michael West, the first cloner of human embryos, explains why the US Congress is unfit to oversee such affairs: Who wants "insurance salesmen from who knows where," he asks, "pontificating on such important issues?" So much for democracy.

Attacking arrogant scientists is bracing but easy. Speaking up for religion is hard. But McKibben does it. He quotes the Bible. He looks to Dueteronomy and the Gospels for spiritual guidance. No doubt Watson would sneer. I would rather listen to McKibben any day.
David Gelernter (dhg@cs.yale.edu) *is a professor of computer science at Yale and chief scientist at Mirror Worlds Technologies.*

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In the Driver's Seat

Breaker, breaker. A convoy of big rigs is rolling down the virtual pike straight into your game console. Developers say they've captured the feel of driving a 20-ton vehicle – accelerating to full speed can take almost a minute, and a sharp turn will send an 18-wheeler rolling. *Wired* asked 14-year veteran of the road Tony Graziano to take Empire Interactive's *Big Mutha Truckers* and Sega's *King of Route 66* for test drives. **– Suzanne Ashe**

Music

Tony says: Tunes can make the miles pass quickly – or seem excruciatingly long. The *King of Route 66* soundtrack, which features screaming *Top Gun*-style anthems, was a buzz kill. *Big Mutha Truckers* had an ample radio dial, but only one country station. "Where's the Waylon Jennings? Where's the Willie Nelson and Merle Haggard?"

BMT

Realism

Tony says: The laws of physics don't always rule. In *Route 66*, a pickup truck had enough torque to toss a big rig off its course. *BMT* asks you to forget everything you learned in science class: "A guy jumped from his motorcycle onto the back of the trailer and crawled up toward the cab. I slammed on my brakes to shake him off, but it didn't work. Apparently Newton's first law doesn't apply in his universe."

Route 66

Handling

Tony says: It's all about the feel behind the wheel. The tractor and the trailer realistically interacted when backing up and making tight turns in both games. *BMT* prompted shifts, but it didn't replicate the sensation of a 10-gear engine. *Route 66* offered only forward and reverse. "Shifting is an art form. In a truck, gears are asynchronous. If you shift too early, you'll strip them."

BMT

SIMS VS. REALITY: A BIG RIG TRUCKER BREAKS IT DOWN

Wardrobe

Tony says: The trucker uniform is a pair of Wranglers, a plaid shirt, and a baseball cap. Across the board, the characters' costumes – from ninja to disco king – seemed a bit far-fetched, if not uncomfortable, for long hauls. "Bobbie Sue drives in a checked bikini top. You don't see that every day."

BMT

Truck stops

Tony says: The travel plaza is a trucker's home away from home. *Route 66* hit pay dirt with its A&W-style drive-up and full-service stations where calling home, scheduling hauls, and checking road conditions was a snap. In *BMT*, the truck stops were just a pause between levels. Lame. "A truck stop is like the bar in *Cheers*. You know, 'where everybody knows your name.'"

Route 66

The War Room

Who said gamers were antisocial? Now they have a coliseum dedicated to public exhibitions of showmanship. San Diego's ESports Arena holds 102 networked gaming stations, each outfitted with a 15-inch monitor, a PS2, an Xbox, a GameCube, a PC, noise-canceling headphones, and 3,000 games. Eight bucks buys two hours of weekend action. Players go at it solo or in teams, while an emcee tracks the battles and routes the fiercest fights to the converted theater's original 30-foot screen for all to see. Owner John Varley plans to open 400 more arenas nationwide over the next four years, starting in New York, Los Angeles, and Chicago. "We're providing a place for gamers to not only compete with friends," says Varley, "but to face off against celebrities, media, and business leaders. It's the true revenge of the nerds." **– Steven Kotler**
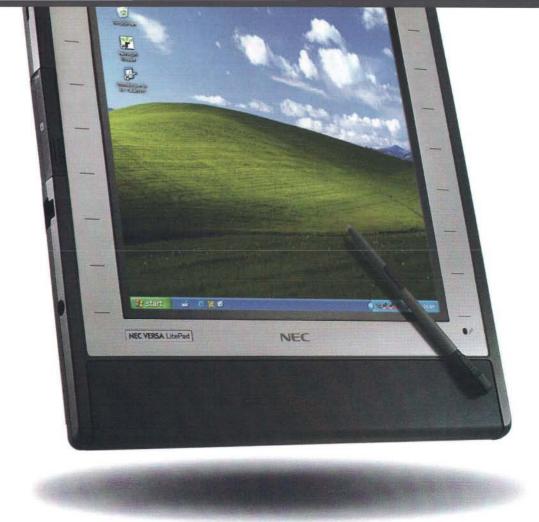
THIS ARCADE'S FIERCEST FRAGS
PLAY OUT ON A 30-FOOT SCREEN

Better Than a Joystick

No ordinary peripheral, Sega's mouselike Trance Vibrator pulses in time with its PS2 shooter *Rez*, emitting vibrations four times stronger than rumble controllers like Sony's Dualshock. As you advance through the game's levels, the tremors intensify. "You can put it anywhere – your foot, your back, your waist," says Tetsuya Mizuguchi, *Rez's* creator. "It's up to our customers' imagination." And what imaginative customers Sega has. Female gamers in Japan are putting the peripheral between their legs. (No word yet on when it will be available in the States.) The company doesn't recommend using the device as a sex toy, but it does come with a washable protective pouch. And with a name like Trance Vibrator, what did Sega expect? **– Chris Kohler**

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Sampladelic!

Drew Daniel goes nuts with the *Party* mix

Even renegade samplers like the Bomb Squad and M/A/R/R/S never went as far as Matmos' Drew Daniel does on his solo debut, *Do You Party?* Under the moniker The Soft Pink Truth, Daniel cuts up Yiddish comedy records, '70s public-service announcements, phone sex pranks, and other found material to produce an amazing, totally schizo album. It's laptop techno as innovative as wild-style reinterpreters like Kid 606, but without the aural aggression. Here's what went into the *Party* mix. – Ethan Brown

Match the artist with the sound — Quiz!

1) 4 Hero
2) Kit Clayton vs. Safety Scissors
3) Lil' Louis
4) Chuck D
5) Armand Van Helden
6) Indeep
7) Matmos

A) Orgasmic groans
B) Running saw
C) *Star Trek*
D) Ping-Pong game
E) Burning rubber
F) Liposuction
G) Toilet flushing
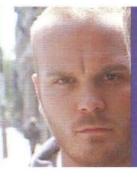
Answers: 1 C; 2 D; 3 A; 4 E; 5 B; 6 G; 7 F

SONG TITLE: "Make Up"

THE SAMPLES: The raunchy, Prince-era synth funk of Vanity 6's 1982 hit "Make Up" gets a 21st-century makeover. Daniel amplifies the bass line until it wobbles, then splices in voices for the chorus: "Smoke a cigarette / I'm not ready yet."

THE SOUND: Bootsy Collins and Giorgio Moroder meet for drinks over a Speak & Spell.

SONG TITLE: "Gender Studies"

THE SAMPLES: Scads of obscure soul songs with choruses that contain the word *girl*. Behind it all is a buoyant house beat reminiscent of Daft Punk's *Da Funk* dynasty.

THE SOUND: A hilarious take on the polysexual subtext of soul music, from the Delfonics to Dru Hill.

SONG TITLE: "I Want to Thank You"

THE SAMPLES: Piecing together recorded voices and sound effects, Daniel thanks his friends and collaborators. Then, in a move few artists would dare to make, Daniel has several voices spell out his home address.

THE SOUND: A gloriously ballsy high for the genre that recalls De La Soul's masterpiece *3 Feet High and Rising*.

WHAT'S ON YOUR iPOD?

WILL CHAMPION

Coldplay
The tunes at the top of his playlist:

[01] Dennis Wilson / "River Song"
[02] David Axelrod / "Holy Thursday"
[03] Neu! / "Hallogallo"
[04] Christy Moore / "Ride On"
[05] Kris Kristofferson / "Help Me Make It Through the Night"
[06] Dusty Springfield / "I Can't Make It Alone"
[07] Ralph Stanley / "Calling You"
[08] Dusty Springfield / "Just a Little Lovin'"
[09] Aretha Franklin / "The Weight"
[10] Black Eyed Peas / "Fallin' Up"

JAPANESE SCHOOLGIRL WATCH
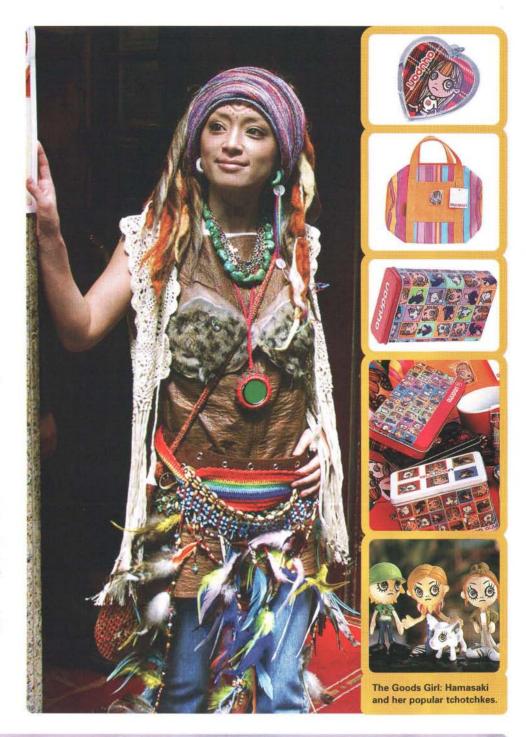
Ayumi Inc.

What does it take to be queen of the J-pop scene? Twenty-eight hit singles, blond extensions, and a doughnut-endorsement contract. Ayumi Hamasaki, 24-year-old songstress turned merchandising phenom, has built a multimillion-dollar empire by hawking the conventional (her own J.Lo-esque clothing) and the very strange (a Mister Donut special: four rings of deep-fried dough, two sparkly trading cards, and three drink coasters).

The pop star's Ayupan line includes key chains, pencil holders, and lunch boxes featuring her cartoon likeness. Her series of creepy, doe-eyed figurines is so popular, her followers have been known to pick up 300 at a time, creating a Beanie Baby-like craze. The extreme demand has led to the opening of a Tokyo store dedicated to the Hamasaki doctrine. Resistance is futile.
– J. Mark Lytle
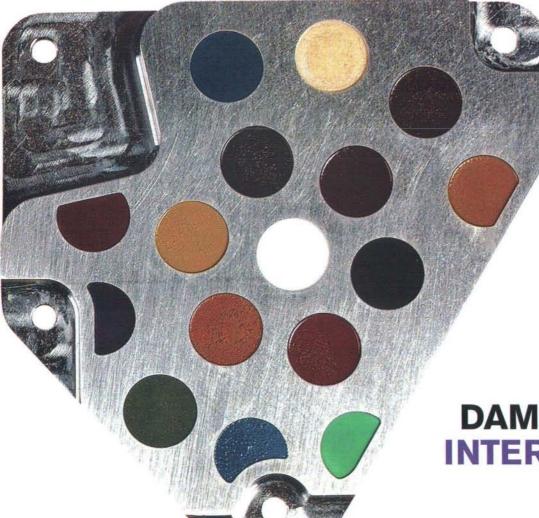
JAPAN'S ANSWER TO BRITNEY SPEARS

The Goods Girl: Hamasaki and her popular tchotchkes.

The Race for 10th Place

Cheating is encouraged, bribes are expected, and whoever crosses the finish line first comes in last at the annual East Coast Kinetic Sculpture Race. Roughly 20 weekend engineers race their human-propelled art – from simple, one-pilot crafts to complex, multidriver vehicles – made of beer kegs, papier-mâché, bicycle parts, and stuffed animals. The 15-mile street course features muck, ice, and water obstacles. The contestants, their rides, and their requisite homemade sock creatures battle in Baltimore on April 26 for the most coveted prize of all: the Mediocre Award, presented to the driver who finishes the nine-hour race smack in the middle of the pack. "Everyone who enters is a winner, even if they have to drag their machine across the finish line. The silly awards are just meant to point that out," says Jeff Bartolomeo, whose Bartmobile Oakland Mills Scorpion (left) took home the Golden Dinosaur Breakdown Award when it went through seven emergency spot welds during 2002's run. **– Michelle Delio**

A Brush With Mars

After shocking the art world with his dissected-animal installations, British rebel Damien Hirst decided to seek an entirely different audience for his work: Martians. Hirst — who is renown for his paintings of large, colored circles — engineered this 3-by 3-inch palette for the European Space Agency's Beagle 2 Mars probe, set to launch by late June. Hirst's piece is more than mere eye candy: It's designed to calibrate the lander's instruments. Each of its 16 colors represents a compound found on Earth — including iron, cobalt, and manganese — so the craft's mini-spectrometer can compare known elements with whatever it finds on the red planet. The palette will be suspended in clear adhesive, so it can endure the seven-month journey to Mars and still wow any extra-terrestrial critics. — **Sonia Zjawinski**

DAMIEN HIRST'S INTERPLANETARY PALETTE

Eastern Unorthodox

Japan is so overtly futurist, it's no surprise that modern technology is influencing the current crop of graphic designers. "Japan must now be considered a country where culture comes from technology, not technology from culture," writes Tsuyoshi Hirooka in *JPG: Japan Graphics.* The new book chronicles how 25 designers — some of whom never went to art school — are mixing emerging tech with traditional formats to transform how we look at paper (*Brutus* magazine), the Web (*www.cryogenicx.com*), and television (digital animation like *Oyaji*). The 420-page collection features everything from Java-enhanced cell phone screen images (far left) to deconstructive Aibo illustrations (left). You know, the stuff that inspires American designers. — **Alison Willmore**

games

PC
Torero

Here's your chance to stare down a pissed-off 1,500-pound bull – from a safe distance. The world's first 3-D bullfighting sim comes out of Spain complete with saucy flamenco music. Though commands like "Perform a large *cordobesa* to the right" will undoubtedly confuse gringos, it's worth buying *Torero* just to position your matador, picador, or banderillero in the path of a hulking beast and get violently gored. Note: To get the full effect, toggle on the blood. – **Joshua Davis**

PS2 CUBE
Def Jam Vendetta

This no-holds-barred mix of martial arts, pro kickboxing, and WWE grappling plays like *Fight Club* at the Apollo. In a series of underground matches, you become and take on neighborhood thugs and hip hop heavyweights like Method Man, Redman, and DMX – all of whom made sure their characters looked just right (Meth requested an ice-pick pendant, DMX a dog chain). Star power aside, *Def Jam Vendetta* would be fun even if it had you brawling as Lawrence Welk. – **Paul Semel**

music

Autechre
Draft 7.30

Somewhere between computerized noise and postindustrial groove you'll find the music of Autechre. The Sheffield duo's latest album is its most lucid to date, but its piercing percussion blasts, distorted mechanical clattering, and synthesized ambient riffs still border on sonic dystopia. *Draft* unspools like a dream-time narrative, moving from virtual pastorals to fanciful fits of techno-funk. It's an intrepid reimagining of instrumental hip hop that would make Bambaataa proud. – **Joseph Patel**

The White Stripes
Elephant

Jack and Meg White pen simple blues songs that pack operatic wallop. Fueled by vintage guitars (still no bass), drums, and Jack's doleful howl, *Elephant* proves that studio wizardry isn't necessary when you've got genuine talent. Layering slide guitar over steel-toed Motor City punk, the Stripes kick rock and roll back into the garage, then dial it back with a surprisingly tender cover of Burt Bacharach's "I Just Don't Know What to Do With Myself." – **Adrienne Day**

screen

DVD
Babylon 5: The Complete Second Season

At first, *Babylon 5* seemed like just another sci-fi series set on a space station. But by the second season, in 1995, creator J. Michael Straczynski set his epic apart with deeper themes (it's still the only TV show with a Jungian subtext) and complex characters (the doctor eventually develops a drug problem). The six-disc set's widescreen format really does justice to the saga's CG effects – among the first to hit the small screen. – **Robert Levine**

THEATERS
The Dancer Upstairs
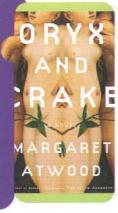
John Malkovich's directorial debut harkens back to the moody understatement of leftist political thrillers like *Z* and *Breathless*. *Dancer* has that grainy, Nouvelle Vague look and is even subtitled in many scenes. But Malkovich sets his film in an unnamed Latin American country and infuses Incan mysticism into a Marxist terrorist group's struggle against a corrupt regime. Javier Bardem lends tortured elegance to his role as hero cop, a performance only Malkovich himself could top. – **Beth Pinsker**

print

Oryx and Crake
Margaret Atwood

The Booker Prize-winning author makes another deft foray into literary sci-fi. Set in a near future scorched by genetic experimentation and environmental destruction, the story could have been lifted out of a Greenpeace nightmare: Chickens bred for fast food are barely more than legs and mouths, and man-made viruses dissolve a person's internal organs in hours. Short on tech but long on resonance, the book's central question is a haunting one: Is humanity worth saving? – **Alison Willmore**

Isaac Newton
James Gleick

Everyone knows Isaac Newton came up with the theory of gravity. Who knew he was also a nut? Gleick's Newton led a "strangely pure and obsessive life, lacking parents, lovers, and friends." Freakishly secretive, he wandered the university grounds with his stockings at his ankles and scratched diagrams into campus gravel. While Gleick doesn't shirk on the Cambridge scholar's accomplishments, his biography reads like a 17th-century *People* magazine. – **Jennifer Kahn**

In this case, the attraction
is automatic.

zoom-zoom

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WISH**LIST**

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Memorex 4x DVD+RW/+R Drive

The upcoming Memorex Internal 4x DVD+RW/+R Drive lets users record up to 4.7GB of video, data, photo or audio files at twice the speed currently available. With this complete, easy-to-install kit, there is no better storage solution.

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Memorex MX3300 Multimedia Office Keyboard

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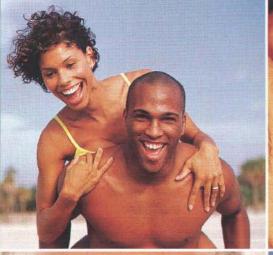
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WIRED LIVE
EVENTS & PROMOTIONS

WIRED IN CANNES

FUTUREPLEX

HOW THE INTERNET IS CHANGING THE MOVIES

PANEL DISCUSSION

May 19, 2003 • American Pavilion
Cannes Film Festival

Cinema is a compendium of technological break-throughs. In the 1920s it was sound. In the 1980s and '90s it was computer-generated special effects. Now new digital technologies are about to change the way we experience film. As movies on demand become a reality and wi-fi makes it easy to watch on the go, movie-goers will be freed from the con-straints of time and place. What are the implications for filmmakers? What else do technologists have in store? "WIRED IN CANNES" brings together film-makers, executives, and technologists to grapple with the questions the Internet brings to movies.

CONFIRMED PANELISTS

DAVID PERLMUTTER
Vice President and Co-general Manager
Intel Mobile Platforms Group

MARC SHMUGER
Vice Chairman
Universal Pictures

Moderated by WIRED Contributing Editor
FRANK ROSE

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A SERIES OF
EVENING READINGS,
FILM, DRAMA,
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AND VINO

VOYAGES:
REAL AND IMAGINED

Produced by authors and Grottoites
Laura Fraser and Jason Roberts
Series Directed by David Ewing Duncan

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Reception to follow at the
San Francisco Writers' Grotto

Dock and Load

LAPTOP **Put this notebook** to work even after powering it down. When off, the half-inch-thick Actius PC-MM10 pulls a second shift as your PC's external hard drive. Just dock the laptop in its charging station, plug the USB cable into your desktop, and – tada! – 15 more gigs of space for all your OutKast MP3s. And don't worry about duplicate data: Sharp's software automatically syncs files on both machines, so you're always up-to-date. Actius PC-MM10: $1,499, *www.sharpsystems.com*

THE SYSTEM THAT NEVER SLEEPS

SHARP

READY
HDD
OFF   ON

by Seth Feman

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VIDEO *AND* STILLS

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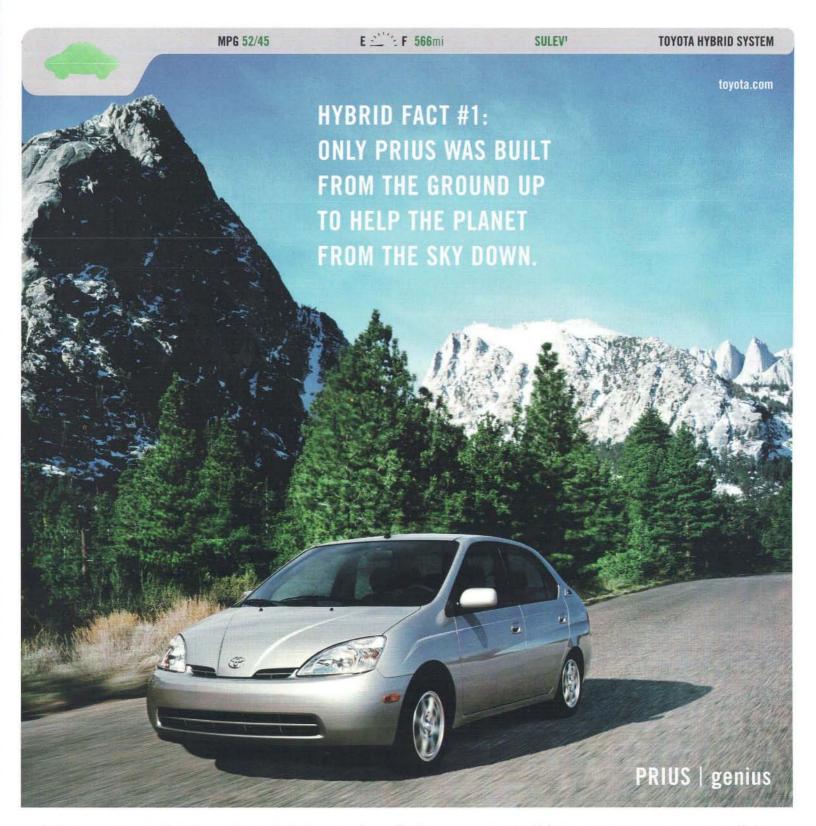
`DV CAMCORDER` **Who says** you can only shoot snippets of video with a digicam or low-grade photos with a camcorder? Samsung's SCD5000 pairs a 4.1-megapixel shooter with a 10X optical-zoom DV camcorder for capturing high-quality stills and full-length films. Rotate the lens' chassis 180 degrees to switch functions. Movies are saved onto MiniDV cassettes, and photos are uploaded onto Memory Sticks, so your creativity is limited only by your media stockpile.
SCD5000: $1,499, *www.samsungusa.com*

iPurse

`MP3 ACCESSORY` **If owning** an iPod didn't make you enough of an early-adopting show-off, try the pleather Groove Bag by Felicidade, which blends ghetto blaster functionality with Gucci style. The built-in speakers plug into your iPod's headphone jack, and the MP3 player tucks into a peek-a-boo zippered pocket in the purse. Fashion tip: Pick up some Prada shoes to match.
Groove Bag: $139, *www.drbott.com*

RIP IT, BAG IT, PLAY IT

MORTEN KETTEL, STYLED BY MICAH BISHOP

FLAT-PANEL PLASMA TVs

Going Wide

Videophiles who like their input hi-def and widescreen should take note – plasma displays still offer far more brightness and clarity than their LCD competitors. Now that prices for luxurious 42-inch flat panels are actually falling into used-car range, it may be time to upgrade. – Peter Suciu

SPLURGE

Sharp PZ-43HV2U
With the PZ's 160-degree viewing angle, there won't be a bad seat in your home theater. The 1,024 x 768 resolution and ultrahigh contrast ratio provide an astonishingly crisp picture, even with ambient lights on. The lifelike colors are highly adjustable, and five display modes accommodate the aspect ratio of whatever you're watching. This wall-mountable model might just be the final word in plasma.
$10,000, www.sharpusa.com

BEST BUY (SHOWN)

Hitachi 42HDT20
Using a technology called alternate lighting of surfaces (ALiS) developed through a partnership with Fujitsu, Hitachi offers one of the brightest plasma displays on the market. Its maximum resolution: 1,024 x 1,024. What's more, the sleek audio-video control center can be positioned away from the set, reducing the number of unsightly wires.
$8,000, www.hitachi.com

OVERRATED

Gateway 42-inch Plasma TV
This HD-compatible screen costs a fraction of what most comparable sets do – and with good reason. It may be slim and sexy, but it scales down higher resolutions to 852 x 480; and when it comes to the color, it ekes out anemic black, leaving the reds looking orangy. (The set is made by Sampo in Taiwan, a company not known for high-end electronics.) Go Gateway for a PC monitor, and go elsewhere for a television.
$3,000, www.gateway.com

NIGHT VISION BINOCULARS

When Darkness Falls

Twilight hikes, nocturnal wildlife observation, reenacting tense scenes from Tom Clancy novels – all perfect excuses to pick up a pair of see-in-the-dark binocs. Photocathode tubes magnify existing light so you can explore the gloom in all its eerie, green-tinted glory.
– Alison Willmore

SPLURGE

ATN Night Shadow Gen 4
The 2.2-pound Night Shadow offers stunningly clear images that exceed anything else on the market, thanks to military-grade technology that's thrillingly illegal to export. Also included: 5X magnification, digital controls, an infrared mode that most people won't need, and a proximity sensor that turns the glasses off when not in use. Details like individual blades of grass are as plain as day after dark. Excessive? Never.
$5,995, www.atncorp.com

BEST BUY (SHOWN)

Newcon Optik BN-5
The tough little BN-5 has a rubber-armored body to resist weather – and take abuse from butter-fingered users. Though it's heavier than some (2.65 pounds), it has a smart, no-nonsense design that places buttons and adjustable eyepieces exactly under your index fingers. While the BN-5 has only 2.4X magnification, it makes the most out of its basic optical tubes for great clarity – despite a slight fish-eye effect.
$699, www.newcon-optik.com

OVERRATED

Night Owl Night Hawk
With its sleek one-piece construction, the Night Hawk weighs a mere 2 pounds. Unfortunately, the flimsy plastic shell isn't adjustable, and the eyepiece comes from the Fisher Price school of design. Magnification is 4X, but details aren't as sharp as the Optik's, and infrared washes out anything nearby. The Night Owl line is easy to find at chain stores, but take the time to seek out better-quality products elsewhere.
$499, www.nightowloptics.com

Shopping Cart
What *Wired* staffers bought this month

My Samsung i330 phone runs Palm OS 3.5. The speedy 3G data connection is always on, so there's no wait to check email, read *The New York Times*, or scan movie listings. And with the built-in speakerphone, I can chat with friends while simultaneously scribbling in my datebook – all previously unnecessary luxuries that now, somehow, I can't live without. – **Joseph Portera**
SPH-i330: $500, www.samsungusa.com

Size isn't everything! Mario and Yoshi speed, spin, and crash – not onscreen but as 2-inch remote control racers. The 3.0 motor upgrades mean I can hit 30,000 rpms. The race track accessory is great, but I prefer to go off road, where my English bulldog is more than happy to play the part of Bowser, chasing the cars to the finish. – **Darrin Perry**
Bit Char-G RC cars: $57 each, www.kidrobot.com

My outfits weren't getting enough catcalls, so I bought myself a Singer Free Arm sewing machine. I don't know jack about needles, thread, or how to spool one of these, but let me tell you, this baby is a cinch to put together. And with 30 stitch functions and twin-needle capability, I'm sewing a Sonia Z. line that Gwen Stefani is gonna cream over. – **Sonia Zjawinski**
Singer 13012: $200, www.singershop.com

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> Computers > Software > **Electronics** > Video Games > Movies > Music > Books > Toys > Office Products

QUESTION

Are full-body scans the last word in preventive medicine?

Dan Parker
CEO and owner, Vitascan TM
No, but full-body scans will become indispensable to traditional exams. Conventional tests for heart disease – cholesterol levels, treadmills – are very poor indicators. And no one likes to endure the invasiveness of a colonoscopy; 85 percent of people currently go untested. The medical and insurance communities will soon realize that a test that costs $1,000 dollars can prevent a heart attack that costs tens of thousands, or cancer that can cost millions.
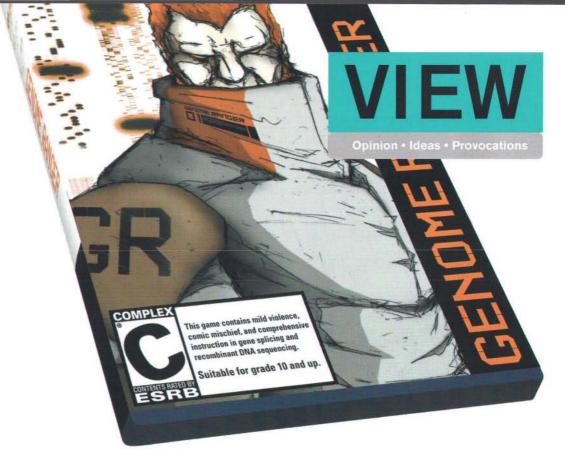
Suzanne Somers
Patient, actress, and fitness product guru
My unbridled curiosity about what's going on inside my body drove me to get a scan. I am happy to report that everything was normal. It's reassuring to be able to look inside your body and check on plaque in the arteries and on the health of vital organs. I suspect that in the future the scan will become such an integral part of being proactive about one's health, there will be a lot more machines, which hopefully will bring down the cost for everyone.

Ralph P. Lieto
Chair, Radiation Protection Committee, American Association of Physicists in Medicine
There are patients who get the test not because they're displaying any symptoms or because they're in some high-risk group, but just because they have the cash. CT scans represent significant radiation exposure: The dose you get from a mammogram is about two-tenths of a rad; for a CT scan, it can be 10 to 20 times greater. But technology has shown that you can run the same tests with less of a dose, so we're leaving the door open.

COMPLEX **C**

This game contains mild violence, comic mischief, and comprehensive instruction in gene splicing and recombinant DNA sequencing.

Suitable for grade 10 and up.

CONTENTS RATED BY
ESRB

High Score Education
Games, not school, are teaching kids to think.
by James Paul Gee

The US spends almost $50 billion each year on education, so why aren't kids learning? Forty percent of students lack basic reading skills, and their academic performance is dismal compared with that of their foreign counterparts. In response to this crisis, schools are skilling-and-drilling their way "back to basics," moving toward mechanical instruction methods that rely on line-by-line scripting for teachers and endless multiple-choice testing. Consequently, kids aren't learning how to think anymore – they're learning how to memorize. This might be an ideal recipe for the future Babbitts of the world, but it won't produce the kind of agile, analytical minds that will lead the high tech global age. Fortunately, we've got *Grand Theft Auto: Vice City* and *Deus X* for that.

After school, kids are devouring new information, concepts, and skills every day, and, like it or not, they're doing it controller in hand, plastered to the TV. The fact is, when kids play videogames they can experience a much more powerful form of learning than when they're in the classroom. Learning isn't about memorizing isolated facts. It's about connecting and manipulating them. Doubt it? Just ask anyone who's beaten *Legend of Zelda* or solved *Morrowind*.

The phenomenon of the videogame as an agent of mental training is largely unstudied; more often, games are denigrated for being violent or they're just plain ignored. They

shouldn't be. Young gamers today aren't training to be gun-toting carjackers. They're learning how to learn. In *Pikmin*, children manage an army of plantlike aliens and strategize to solve problems. In *Metal Gear Solid 2*, players move stealthily through virtual environments and carry out intricate missions. Even in the notorious *Vice City*, players craft a persona, build

PIKMIN TAKES PROBLEM-SOLVING TO A NEW LEVEL

a history, and shape a virtual world. In strategy games like *WarCraft III* and *Age of Mythology*, they learn to micromanage an array of elements while simultaneously balancing short- and long-term goals. That sounds like something for their résumés.

The secret of a videogame as a teaching machine isn't its immersive 3-D graphics, but its underlying architecture. Each level dances around the outer limits of the player's abilities, seeking at every point to be hard enough to be just doable. In cognitive science, this is ➡

referred to as the regime of competence principle, which results in a feeling of simultaneous pleasure and frustration – a sensation as familiar to gamers as sore thumbs. Cognitive scientist Andy diSessa has argued that the best instruction hovers at the boundary of a student's competence. Most schools, however, seek to avoid invoking feelings of both pleasure and frustration, blind to the fact that these emotions can be extremely useful when it comes to teaching kids.

Also, good videogames incorporate the principle of expertise. They tend to encourage players to achieve total mastery of one level, only to challenge and undo that mastery in the next, forcing kids to adapt and evolve. This carefully choreographed dialectic has been identified by learning theorists as the best way to achieve expertise in any field. This doesn't happen much in our routine-driven schools, where "good" students are often just good at "doing school."

How did videogames become such successful models of effective learning? Game coders aren't trained as cognitive scientists. It's a simple case of free-market economics: If a title doesn't teach players how to play it well, it won't sell well. Game companies don't rake in $6.9 billion a year by dumbing down the material – aficionados condemn short and easy games like *Half Life: Blue Shift* and *Devil May Cry 2*. Designers respond by making harder and more complex games that require mastery of sophisticated worlds and as many as 50 to 100 hours to complete. Schools, meanwhile, respond with more tests, more drills, and more rigidity. They're in the cognitive-science dark ages.

We don't often think about videogames as relevant to education reform, but maybe we should. Game designers don't often think of themselves as learning theorists. Maybe they should. Kids often say it doesn't feel like learning when they're gaming – they're much too focused on playing. If kids were to say that about a science lesson, our country's education problems would be solved.

James Paul Gee, a reading professor at the University of Wisconsin-Madison, is the author of What Video Games Have to Teach Us About Learning and Literacy.

IF A GAME ISN'T SMART, IT WON'T SELL WELL

hot seat

Rick Boucher

Five years after it was enacted, the Digital Millennium Copyright Act is living up to critics' worst fears. The antipiracy law has become a broad legal cudgel that's wielded against legitimate reapplications of intellectual property, from mix CDs to off-brand toner cartridges. Representative Rick Boucher (D-Virginia) has written the Digital Media Consumer Rights Act (HR 107), which would make it legal to, among other things, create an archival copy of a CD or DVD. Good fix for a bad law – but why not just blow up the DMCA instead? – **Lucas Graves**

Can the DMCA Be Fixed?

WIRED: Are you trying to defang the DMCA by reasserting fair-use rights?
BOUCHER: I'm reluctant to make a really broad statement, because no sooner would I say that than I would have those words quoted back to me by [Motion Picture Association of America president] Jack Valenti. HR 107 does not defang the DMCA with respect to people who are trying to commit piracy. It does, however, defang the DMCA with respect to the innocent, with respect to the purchase of digital media for legitimate purposes.

Where was the DMCA opposition on Capitol Hill in 1998, when it would have counted?
I was paying a lot of attention then, and in fact I offered the same amendment. Not very many members of Congress were willing to listen to those concerns at the time. Now a much larger external community is determined to make changes – most notably technology companies, which were not a part of the debate in 1998.

What's brought Silicon Valley into the picture?
The realization that the market for technology products and services will be adversely affected as the DMCA bites deeper and inhibits the rights of digital media purchasers. I might add that the entertainment companies will also get hurt: When consumers start finding they can't use the media fully, they will value it less.

You've called the DMCA a testament to Hollywood's lobbying power. How can you win?
Consumer outrage will grow as copy-protected CDs make their way into the market in greater numbers. The public response is going to be visceral, and it will be heard by members of Congress.

Digital piracy has been illegal since the 1976 Copyright Act. Why not just scrap the DMCA?
As a practical matter, it's probably easier for us to make these surgical changes than to simply attempt to repeal the act. And, after all, we're looking for a victory. We're not looking just to make a statement.

SCOTT MENCHIN

special WIRED report: 60-page pullout ▶

The New Cold War

India and China are picking up where the US and Soviet Union left off. by Bruce Sterling

The catastrophic failure of the *Columbia* rocked America's commitment to manned space flight, but it galvanized that of another nation: India. Kalpana Chawla, who died in the disaster, wasn't the first Indian-born astronaut in space, but she was a small-town girl who transcended every third-world limit to storm the cosmos. Her lesson hasn't been lost on a billion Indians.

Nobody in the Western press takes much notice of India's space aspirations, because by Yankee standards it doesn't make sense for India to have any. Yet India launched its first missile in 1963 and its first cosmonaut in 1984. Nobody in the West thought the country would ever go nuclear, either. That was a blunder in judgment.

Nuclear bombs pack a staggering strategic punch when paired with big missiles. Big missiles provide passage to outer space. To loft big payloads into orbit is to have planetary first-strike capability. India's hefty new Agni III nuclear missiles have a 1,860-mile range, and other homegrown rockets are placing small weather and spy sats in orbit. India's space agency, ISRO, plans a $50 million lunar flyby in 2008.

Why is Gandhi's homeland trying to reach the moon when people sleep on the streets in Calcutta and AIDS gnaws the country's flesh? For the same reason the US sloughed off poverty programs to fund Apollo in the 1960s: global prestige.

India doesn't need long-range missiles to nuke neighbor and archrival Pakistan. For a war that intimate, bullock carts would do. The Agni III is aimed straight at world public opinion. The India-Pakistan PR skirmish is already almost over, and India is clearly winning. Every great power sweats bullets over Pakistan's bomb, but India's somehow makes that country worthy of consideration for a permanent seat on the UN Security Council.

Although the Pakistanis have a bomb, they have to scrounge North Korean Scud missiles to deliver it – and therein lies a lesson the ruthless "realists" of India's ruling Bharatiya Janata Party well understand. Pakistan can't compete in a space race with India. Pakistan lacks the big money and the aerospace chops, and if it keeps trying to match India's grand achievements, as it always has, it will end up broke and humiliated.

Pakistan has no counterpart to the Agni III, but China does. China's Long March 2 rocket can launch a satellite and, in its weaponized Don Feng 5 version, drop a 4-megaton warhead practically anywhere on the planet – India most definitely included.

India and China are comers with a lot to prove to the world, and especially to each other. Their rivalry has roots. In a 1962 shooting war, China grabbed some real estate in the Kashmir region and sent India's army reeling. India never forgot the affront, and the dispute still smolders today.

Since India demonstrated its bomb in 1998, the Chinese have been increasingly uneasy. China reacted to the detonation with angry demands that the international community keep India contained. When that got nowhere, China helped Pakistan go nuclear. In retrospect, that was a scary, destabilizing misstep. But now India and China are poised to continue their rivalry on safer high ground – beyond Earth's atmosphere.

Nuclear India versus nuclear China is Kennedy versus Kruschev, and Reagan versus Gorbachev, all over again. Now, as then, a space race is a sexy alternative to nuclear annihilation.

China has openly declared its desire to colonize the moon. The world's most populous nation is unlikely to build lunar settlements, but that's not the point. China's motive lies not in constructing a lunar Hong Kong, but rather in luring India into a loud public competition. Later this year, if all goes as planned, China will become the third country to send a citizen into space. An orbiting taikonaut will be even more impressive if American shuttles are stuck in their hangars while the misnamed International Space Station limps along with a skeleton crew.

As Russia once did, China has a strong technical advantage. It already owns a chunk of the commercial space-launch business.

A SPACE RACE IS A SEXY ALTERNATIVE TO NUCLEAR CONFLICT

But India has a decent shot at victory as well. It doesn't have China's manufacturing know-how, but it's rapidly becoming the world's software back office.
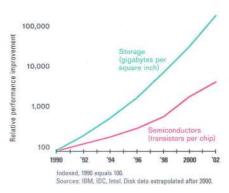
Who will become top dog in South Asia? That's an open question, and there aren't many good ways to answer short of a useless massacre. A space race offers a good solution. It's a symbolic tournament that tests competing political and economic systems to their limit.

A decade after the end of the Cold War, good old-fashioned space programs still matter. Not for exploration's sake, but to settle new cold wars. If you doubt it, imagine this scenario: It's 2029, and a lunar mission lands at Tranquillity Base. A crew of heroic young Indians – or Chinese – quietly folds and puts away America's 60-year-old flag. If the world saw that on television, wouldn't the gesture be worth tens of billions of rupees or yuan? Of course it would.

Email Bruce Sterling at bruces@well.com.

More Than Moore

While the density of transistors on microchips continues to double every year and a half, the track density of hard disks – that is, the number of gigabytes per square inch – is growing at a much faster rate.

Relative performance improvement

Storage (gigabytes per square inch)

Semiconductors (transistors per chip)

1990 '92 '94 '96 '98 2000 '02

Indexed, 1990 equals 100.
Sources: IBM, IDC, Intel. Disk data extrapolated after 2000.

Shifting Into Overdrive

What happens when mass storage leaves microchips in the dust. by J. Bradford DeLong

Those of us with one foot far enough in the grave to have been using computers in the mid-1980s remember our extraordinary liberation from the floppy disk. We were freed from the requirement that all our programs and operating systems and files come in 360-kilobyte, 5½-inch chunks. It was a marvelous advance, the revolution in hard disk technology that gave us 10-megabyte mass storage devices for $1,000.

But it is the advances since then – and those we can firmly see our future promising – that are even more marvelous. Right now I am sitting in front of a whirring 60-gigabyte hard disk that cost less than $100. Do the math: If back then 10 megabytes cost $1,000, then 60 gigabytes would have cost x, where x = $6,000,000 and "back then" = 18 years ago. I'm sitting in front of $6,000,000 worth of mass storage, measured at mid-1980s prices. Happy me!

We have Moore's law for microprocessors. But who's coined a law for hard disks? In mass storage we have seen a 60,000-fold fall in price – more than a dozen times the force of Moore's law, with less than one-hundredth the press excitement.

My entire music library – 1,803 tracks, 128.8 hours of relatively high-quality MP3 files – now sits in what seems like a small 8-gigabyte corner of my hard disk. *San Jose Mercury News* columnist Dan Gillmor carries the entire *Encyclopaedia Britannica* on his laptop – the thing that fills 6½ linear feet on my family room bookshelf takes up 4 percent of his disk space. Today, a $350 investment in mass storage can buy enough space to hold approximately 250 hours – one and a half 24-hour-a-day weeks – of moderate-quality digital video. And tomorrow? I'm willing to guess that by 2012 the $100 mass storage option for PCs should hold a full terabyte.

Computing power and connectivity hogged the headlines in the past decade, but mass storage will take the lead for three reasons. The first is regulatory: It does not look as though we in the United States will get the capital and regulatory structures of telecommunications right fast enough to see the bandwidth explosion that we know is technically possible during the next several years. The second is that keeping up with Moore's law in silicon is becoming more and more expensive. Intel, IBM, et al. are designing the next generations of microprocessors right now. But the cost of a semiconductor fab is now $3 billion and rising – few companies can afford one. The third is that mass storage is very simple: You write marks, you read marks, whether on modern magneto-optical or Babylonian clay-tablet media. What matters is the size and precision of your chisel, and our engineers' technical creativity makes it a favorable bet that the next five or ten years will see connectivity and Moore's law lagging behind the explosion of mass storage.

So, what will the world look like if mass storage is not a limiting factor?

First, the cheaper the disk space, the more dead the traditional business models of the entertainment industry. Money will come from new content for which a premium price based on must-haveness can still be justified, much like the hardcover-softcover distinction in bookselling. Substantial money will also come from special big-screen, live, and other experiences that cannot be duplicated at home. It's not that information – in the multimedia content sense – wants to be free. Deep in people's minds is a powerful human drive to exchange, to reciprocate, to not just take but also give. But reciprocity works only if the terms of the exchange are seen as fair.

Second, the overwhelming cheapness of storage will lead to the apotheosis of librarianship – or, rather, of search. Overwhelmingly cheap storage means that we will save copies of everything. But saved copies of everything are useful only when you can find what you are looking for. I already find it much, much easier to locate things on the publicly accessible part of my hard disk that is *www.j-bradford-delong.net* than in my private directories. Why? Google. Other people have omnivorously plowed through the directories opened up to the world, and Google has aggregated the Web traces they have made. Intelligence – artificial or otherwise – at assessing the value of documents and their relevance

BRITANNICA ON YOUR iPOD IS JUST THE BEGINNING

to you may well become the truly scarce factor. And one of the basic principles of economics is that the truly scarce factor is highly rewarded. Google's children will be a big part of the picture. Tomorrow's movie studio profits may well accrue to the studio that can write the best algorithms to download copies of the 50 films you'd most enjoy to your hard disk overnight.

Finally, and most important, your memory will improve. There will be space to store whatever you wish to recall from your day – pictures of people you saw (grabbed from the Internet), words you heard (recorded via laptop microphone and then translated into text), not to mention whatever thoughts you found time to write down. Your life is your archive, and your archive is your life. Forgetting will be much more difficult – unless, of course, you want to. Then you can always edit it.

Contact J. Bradford DeLong at www.j-bradford-delong.net.

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world-class vehicle? The ability to scale

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WIRED GEAR

HUMAN POWER

by Andrew Tilin
photographs by Mike Lorrig

In sports, man is still the ultimate machine. But the right equipment can help even the most finely tuned athlete move faster, ride farther, and pull off cooler tricks. Here's a look at the latest breakthroughs in materials and designs.

TRICK BOARDS

1 Lib Technologies E-Matrix Maple

SPECS: The heavy maple bottom is the only thing traditional here. Recessed fiberglass and graphite sandwich three layers of vertically laminated birch and aspen, which provide the same durability at nearly half the weight.
PERFORMANCE: It sounds like a Frankendeck, but it's greater than the sum of its parts. Graphite keeps it springy, fiberglass makes it light, and plastic edges shield it from dings.
UPSHOT: The E-Matrix Maple strikes a perfect balance between high tech and old-school. Still, it may feel too synthetic for some Luddite park rats, despite the attention to re-creating the responsiveness of wood.
$60 (deck only), *www.libskates.com*

2 Comet compTop

SPECS: A few kickflips can reduce a five-ply wood deck to kindling, so compTop uses a sheet of carbon fiber topped with basalt cloth, which keeps it strong and 10 to 20 percent lighter than a traditional board.
PERFORMANCE: The compTop is a supermodel of the skating world, and its low weight means it's easier to maneuver. The board's durability doesn't just save you money; fewer deck replacements means it's ecofriendly to boot.
UPSHOT: The prickliest traditionalist will have a hard time finding fault with the board's bounce – it's as close to solid maple as a composite can get.
$55 (deck only), *www.cometskateboards.com*

Additional reporting by Joseph Portera, Eric Steuer, and Alison Wilmore

1

1 Sector Nine Speedboat

SPECS: It's more than 4.5 feet long, but this surfboard on wheels is surprisingly light – just 12 pounds for its 13 layers of birch.
PERFORMANCE: The Speedboat carves like a dream, but as with any oversize board, the mechanics of turning involve more than just shifting your weight. In fact, for sharper turns, you may have to move to an entirely different position on the board.
UPSHOT: This whopper is sure to attract attention – riders uncomfortable with gawks and stares need not apply. But the Speedboat backs up its flamboyance with solid construction.
$150, *www.sector9.com*

2

3 Carveboard Sports Fatty Stik

SPECS: The 33-inch Fatty Stik has dual spring-loaded trucks that let you angle almost 45 degrees to the ground for snappy turns. The contact surface of the flared urethane wheels can expand as needed for better grip.
PERFORMANCE: The Stik's kinda short for a longboard, but its slightly concave deck provides loads of control and easily handles rail-to-rail riding and snappy turns.
UPSHOT: This unit is perfectly geared for running smooth banks. But note that soft urethane wheels have been known to stall on pebbles and asphalt cracks. Be aware, or you'll end up with a nasty road rash.
$214, *www.stik.com*

3

2 Arbor The Bomber

SPECS: The Bomber has a sturdy 45-inch deck – 7 plies of hard maple topped with a layer of Hawaiian koa wood – that'll please the hang ten set. A spray-on grip finish eliminates the need for tape.
PERFORMANCE: This ride was designed for control – the longer wheelbase provides increased stability, and its wide nose allows you to get both feet over the front truck and take charge of speed wobbles.
UPSHOT: Arbor's better known for its snowboards, but they've built a sleek, versatile cruiser for everyday joyriding as well as downhill carving.
$70, *www.arborsports.com*

MUST HAVE

STOWBOARD

Junk your Razor scooter – this portable aluminum deck folds down from 31 inches to 11. The low center of gravity, conical rear wheels, and front steering make carving easy for novices.
$129, *www.stowboard.com*

INLINE SKATES

1 Salomon Deflector2

SPECS: This street-smart model has a short, heavy-duty composite nylon frame that can be adjusted to suit any road condition or skating style. The boot also has dual-density shock absorbers and a vented liner.

PERFORMANCE: The durable Deflector is designed to take a daily beating. The armor-like shell holds a boot that molds nicely to your foot.

UPSHOT: An all-around workhorse suited for most kinds of urban skating. It's not really for tricks, but it's tough enough to handle jumps and even do a little grinding.

$199, www.salomonsports.com

2 Rollerblade Aero 9

SPECS: Skeletal channels in the shell of this skate's minimal frame transfers energy from your stride directly to the wheels. The porous boot liner maximizes air flow.

PERFORMANCE: The sleek Aero is built for speedy street cruising and intense workouts. The under-arch shock absorber completely tames rough road and dulls the feet-numbing vibration of polymer on concrete.

UPSHOT: With an exceptionally comfortable boot, the Aero 9 is great for endurance runs or morning commutes – the custom fit mechanism lets you slip in and out of the boot in a matter of seconds.

$219, www.rollerblade.com

3 Razor Murda Pro Skate

SPECS: This hardcore street skate has just two wheels, plus replaceable grind plates and heel wings. An integrated backslide plate hugs the heel for tight control, and a snap-off Allen wrench allows for quick tweaks in the field.

PERFORMANCE: The Murda Pro takes to rails with total abandon. A fat H-block replaces middle wheels, so you can grind almost any surface.

UPSHOT: Light, stiff, and stubby, this lace-up boot is more BMX than BMW. Not the quickest or most luxurious ride, but great for short bursts – and definitely the coolest way down a long flight of stairs.

$299, www.razor.com

MUST HAVE

Capix Basher Helmet

It has more foam padding than the competition, and you can accessorize with Capix's C 275 attachable headphones ($25). Soundtrack for cruising (or eating) pavement not included.

$30, www.capixco.com

1 Adidas ClimaCool 2

SPECS: The ClimaCool averts meltdowns by surrounding each foot with mesh and vents. The midsole and outsole have been pared down to two impact-absorbing pods.
PERFORMANCE: The venting really works. And what the arch lacks in padding is more than made up for by a supportive plastic cradle. The sprightly shoe weighs in at 10.5 ounces.
UPSHOT: Heat buildup matters most to fleet jocks who generate a lot of friction and sweat in hard workouts or races. Slowpokes and middle-of-the-pack runners need less mesh and more shoe.
$100, www.adidasus.com

2 Nike Shox TL

SPECS: Eleven hollow foam "Shox" columns make up the midsole, and plastic support plates attach them to the upper portion and the tread. A bit paunchy at 13 ounces.
PERFORMANCE: You can debate the bizarre looks, but not the smooth ride. Those columns provide great rebound without that "pillowy" feel, and seamless cushioning for mileage junkies and Clydesdales.
UPSHOT: Nike Shox could be Air's heir if the shoes get lighter and can accommodate feet striking the ground at odd angles. For now, it works best for straight-ahead – and forward-thinking – runners who don't need motion control.
$150, www.nike.com

MUST HAVE

NIKE TRIAX ELITE

This watch is a wrist coach. It measures heart rate, speed, and distance. It jacks into your PC to graph your fitness progress and download new workouts. It even tells you how far, how fast, and how often to run.
$299, www.nike.com

3 Merrell Flash

SPECS: DIY suspension lets you mix and match three plastic inserts of varying firmness to create a shoe that provides proper stability for your particular style.
PERFORMANCE: The Flash fits snug around the heel and runs wide in the toebox. It weighs a respectable 14 ounces. And the EVA midsole comes in three densities to prevent runners from rolling their feet excessively inward or outward.
UPSHOT: Dialed successfully – there are instructions – the Flash addresses a lot of needs. But if turned improperly, this shoe could wreak havoc.
$90, www.merrell.com

TRAIL SHOES

1 La Sportiva Colorado Trail

SPECS: Pure mountain-gear, from its high-traction tread to its overbuilt upper.
PERFORMANCE: You don't run in the La Sportiva, you steamroll. The shoe isn't terribly heavy (13.5 ounces), but it's well fortified at the toe – and with a nylon plate beneath the EVA midsole, the Colorado shields against roots and rocks. The heel is notched like a hiking boot for good grip on loose descents.
UPSHOT: The no-brainer pick for rugged terrain; you can look up at the sunset without fear of twisting an ankle. But the grippy rubber bottom wears faster than conventional outsoles, so stay off the pavement.
$80, *www.sportiva.com*
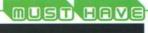
2 Salomon XA Series

SPECS: Lightweight and speedy down to its single Kevlar shoelace. The race-ready, mesh-covered XA slips on like a sock and incorporates minimal padding, protection, and rubber.
PERFORMANCE: It's like Jägermeister – really fun in measured doses. The 10.4-ounce shoe feels feathery on long uphills and, alas, not much more substantial on the descents. Rocks poke at your feet despite a tough polyurethane midsole and thin, fiberglass protection plate.
UPSHOT: A godsend for competitive athletes in grueling adventure races. The rest of us can look elsewhere – maybe at the scenery.
$100, *www.salomonsports.com*

3 New Balance 870 Trail

SPECS: Inject the typical trail runner with steroids and you get the agile and armored 870. A thin yet cushy EVA midsole puts you lower to the ground for good cornering and balance. Rubbery cladding around both toe and heel protect feet from branches and rocks, but it bulks up the shoe to 10.6 ounces.
PERFORMANCE: The spare, softish midsole feels great in the shop and on smooth paths, but gets twisted and bent in the rough.
UPSHOT: This shoe does everything decently, but nothing well. Still, if you run on varied terrain, the 870 could be the right compromise.
$90, *www.newbalance.com*

MUST HAVE

HIGHGEAR ALTITECH

Hang this digital compass from a belt loop or a strap on your pack – and glance at the big face to get time, temperature, altitude, direction, and a barometric weather report.
$160, *www.highgearusa.com*

ROAD BIKES

1 Trek 5200 WSD

SPECS: A proven Tour de France racer, now made for women. The modified carbon-fiber frame keeps the bike reasonably light (18.5 pounds) and prevents women, with their (generally) shorter arms and torsos, from bending over too far.

PERFORMANCE: Distaff riders will be in heaven. Twenty-seven gears and short-reach brake levers make starting and stopping easy.

UPSHOT: It's tough to know which came first, the dearth of hard-riding women or their ill-fitting race bikes. Trek's WSD gives women who want to race an option. And don't worry – there's no pink paint.

$2,800, www.trekbikes.com

2 Calfee Dragonfly Custom

SPECS: Cycling's version of an F-16 jet, constructed just for your body and riding style. It weighs only 13.5 pounds thanks to carbon-fiber everything: frame, handlebars, saddle, and wheels.

PERFORMANCE: It's light enough for darting up hills, plenty stiff for sprinting, and comfortable for all-day efforts. Calfee designers custom-build each frame to minimize road shock and maximize strength. Campagnolo's 20-speed drivetrain runs smooth.

UPSHOT: Pure indulgence. Those with the desire – and the money – will get a longtime partner (frame warranty: 25 years).

$7,800, www.calfeedesign.com

MUST HAVE

REVER SADDLE

Looking to trim down your ride? This saddle is only 200 grams (7 ounces). It skimps on foam in the rear, since racers tend to inch forward. Toward the nose, thermoplastic padding prevents trips from becoming completely masochistic. (Out in July.)

$150, www.sellesanmarco.com

3 LeMond Tete de Course

SPECS: This split-personality steed is half titanium, half carbon-fiber. The 16.6-pound LeMond comes with slick, minimally spoked wheels and Shimano Dura-Ace components.

PERFORMANCE: Putting titanium in the Tete de Course's "spine" – the tubes leading from the cranks to the wheels – provides a hint of the satisfying spring of an all-Ti ride. The light aluminum rims and Swiss-made hubs make for sweet acceleration.

UPSHOT: The LeMond is *the* ride for early adopters. Sure, less-expensive all-Ti bikes are less stiff, but they're also a whole lot less cool.

$4,900, www.lemondbikes.com

MOUNTAIN BIKES

1 Fisher Sugar 292

SPECS: Cruising goes off-road. The dual-suspension, 27.6-pound Fisher has unusually tall 29-inch wheels. You can quickly fine-tune how far the rear shock travels for cross-country or longer mad-bomber settings.
PERFORMANCE: Taller wheels roll more easily over obstacles (that's physics for you), and the carbon-fiber seat stays muffle any vibrations not absorbed by the Fox Float rear shock and the Marzocchi Marathon fork.
UPSHOT: 29ers like the 292 are great at holding their speed and accommodating road wheels. But finding a replacement tire in remote Utah could be tough.
$2,750, *www.fisherbikes.com*
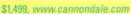
2 Cannondale 1FG HeadShok

SPECS: The one-speed, aluminum-frame 1FG has no shifters and no gears. Even with front suspension and disc brakes, the lively Cannondale weighs just 21 pounds.
PERFORMANCE: The proprietary front suspension mechanism slides beautifully and allows for unusually precise steering. Riding this single-speed is a physical challenge that also requires higher thinking. Like, you better get lots of momentum for that next hill.
UPSHOT: Simplicity is beautiful, and Cannondale made a beauty here. It best suits Lance Armstrong types – you know, those with quads of steel.
$1,499, *www.cannondale.com*

3 Specialized S-Works FSR

SPECS: A cross-country racing machine featuring a light aluminum frame and Shimano's best component system.
PERFORMANCE: You've never felt rear suspension like the FSR's, which employs a standard air-cushioned shock absorber and a second inertia valve. It simply doesn't bob over smooth terrain. Yet on bumpy trails, the rear wheel moves up and down a generous 3.6 inches.
UPSHOT: The FSR's stiff frame moves smartly, and the rear setup is unmatched. But the XTR brake levers have a learning curve: Pull to stop; move up and down to shift.
$4,880, *www.specialized.com*

Inside the Soul of the Web

24 hours watching the world look for answers at Google.

by Michael S. Malone

Mankind's questions unscroll day and night on a computer screen in an office hallway in Mountain View, California.

Workers here at Google were once fascinated to watch the queries climb up and off the screen, two per second, 173,000 per day. But they rarely stop to glance anymore. Most Google employees long ago lost interest in the words and the astonishing numbers they represent: Each of these questions, culled randomly from six giant server farms scattered around the world, represents 1,500 inquiries, totaling 260 million Web searches per day.

Tucson, Arizona >	Krispy Kreme Donuts
Stamford, CT >	Rhumba
Canberra, Australia >	Naturist Boy
AOL, US >	How to Pray to the Rosary

The display sits on a shelf on the second floor of Google's headquarters, which bears a college laboratory meets frat house look. Code writers wander down the corridor in shorts and sweatshirts, often pushing a bicycle or walking a dog. There is a big red ball partially blocking the passage. On the door of the office directly across from the screen, an engineer has posted his doctoral thesis, which was recently accepted by UC Berkeley.

In the two years since it was installed, the monitor has acquired a collection of tchotchkes, like tiny offerings. There's Crash Bandicoot riding a bomb. Gromit in an airplane. A Dilbert M&M's dispenser. A Japanese toy chicken inexplicably wearing a blond wig. A Linux plush penguin. A Halloween spider. And the toothed mechanism from the inside of a music box that, when cranked, plays "As Time Goes By."

Haiti >	Jeune et democratie
Princeton, New Jersey >	Fishnet stocking
Soldotna, Alaska >	Poem procrastination
Iran >	Pulpotomy

The computer screen is divided horizontally. On the bottom, the Google queries, 10 visible at a time, stream up and, after 5 seconds, disappear. Each also carries the location of the questioner, often down to the city, but sometimes only the country, the Internet portal (e.g., AOL), or, when the source is untraceable, just question marks. To honor good manners, the program filters out obscene requests. Whether out of ignorance, faith, or belief in the safety of numbers, an estimated 52 million people around the world, 42 percent of all search engine users, entrust the site with some of their deepest, most vulnerable thoughts and desires.

Alexandria, Virginia >	Marijuana for sell
Netherlands >	Hottest young boys for free
St. Louis, Missouri >	Attracted to my professor
Holmdel, New Jersey >	Horse + penetration

The top half of the screen displays a map of the world that shows where it's day and night. Tiny colored dots twinkle on and off across the continents, each representing a different language and a burst of several thousand questions. Europe, Japan, Israel, Korea, and most of North America are dense, nearly permanent galaxies of dots. In Africa, the Middle East, and South America, the dots are so few that you can often identify precise locations – Brasília, Caracas, Johannesburg, Nairobi, the airport in the Cape Verde Islands.

It becomes apparent that this is a map not just of Google's users but of the spread of technology, and thus of prosperity in the new century. In an imprecise but important way, it is also a measure of human freedom.

AOL >	Eminem
Dallas, Texas >	Walden Pond
Calgary >	Anti flag lyrics
??? >	Emancipation Proclamation
Sao Paolo >	Politics federal de menaus
Bloomfield, Michigan >	Wine + Las Vegas

When you first study the queries, they seem random and inexplicable, an infinite melange of the technical, the perverse, and the trivial. But after a few hours, as your eyeballs begin to rattle from the endless vigil, patterns emerge. Even in cyberspace, there is morning, afternoon, and night.

It is early morning now in Mountain View. In three-hour stretches over the next several days, I will watch the equivalent of an entire 24-hour cycle. On the map the sun is over the Amazon Basin. On the East Coast it is mid-morning, and the queries arriving from there have the crisp earnestness of caffeine-fueled commerce. There are interminable searches about software upgrades, network servers, definitions of financial instruments, and, inevitably:

Orlando, Florida >	Ulcer symptoms

In the wall behind the display, there is a cut-out section, like a drive-up window. Just beyond sits Greg Rae, one of three engineers who created this program two years ago. Now, as the site's log analyst, he devotes much of his day to studying the ceaseless scroll. Wearing gym shorts, T-shirt, and wire-rimmed glasses, Rae is a very tall man in his twenties who looks ready for a workout followed by a long night in a university library. He has now watched several million queries roll by.

Michigan >	Honda 400 ATV shocks
? >	Fat brides
Honolulu, HI >	Timid dog
Bombay, India >	Tarot shops in New Delhi
Atlanta, GA >	Mario chick wit da braids

As the day progresses, the workday questions move west. Three o'clock slides across the continent, and students make their way to the Net. The searches suddenly shift into the land of midterms, research papers, and innumerable misspellings of Britney Spears.

Cambridge, Mass. >	King and Queen of Spain
Houston, Texas >	The Odyssey Homer sparknotes
Sunnyvale, Calif. >	Diet of merchants during the Enlightenment
Berkeley, Calif. >	Church in Weimer Bach cantatas
Honolulu, Hawaii >	Magna Carta
AOL >	Nicole Kidman + boots

Meanwhile, the other half of the globe is blanketed in darkness, entertaining the fever dreams, health fears, and recriminations that come with night. Over their keyboards, lonely souls submit questions into the ether, praying that answers lie somewhere in the vast network – and, if not resolution, then at least succor.

Melbourne, Australia >	Urine cervical specimen chlamydia
Belgium >	Couple voyeur
Tokyo, Japan >	Battlefield 1942
Finland >	Cuckold wife

Darkness crawls across the Atlantic and makes landfall in the Western Hemisphere. On the screen, the West Coast of the United States is ablaze with dots, while only insomniacs and night owls are still typing away in Europe. The noonday sun is now over Indonesia.

This may be the strangest time of all. The predawn monsters of European imagination meet the late-night desires of North America – then all are nearly buried by a deluge of business questions, most in kanji, pouring out of Asia. Amid this flood there are also anxious queries, perhaps from emergency room doctors short of reference books and journals.

Suva, Fiji >	Gestational diabetes - diagnosing
Bhopal, India >	Fecal sac
Iran >	Hymen anatomy
Bangalore, India >	Graze wound
Senegal >	Positions pour amor

Japanese schoolchildren are sitting down to their homework. And the darkest hours are just ahead in Mountain View. Since morning, nearly 160,000 questions, representing more than 235 million queries, have scrolled up the screen. Boredom and exhaustion turn the words into one long smear of human life. Even the kinky ones, amusing a few hours before, are now stale and depressing.

Yet 22 hours into this endeavor, I find it hard to turn away. I have the haunting sense that at any second, something valuable and vital will appear at the bottom of the display, only to disappear at the top five seconds later. I force myself to stay alert for the questions that burn through the humdrum, that force you to try and picture the person who just typed it.

These are the cries for help.

Glendale, Calif. >	How to get rid of pain after getting wisdom teeth pulled
Yuba City, Calif. >	Insulin dosing
Netherlands >	Strep throat in toddler vomiting
? >	Rickets definicion
Diamond Bar, Calif. >	Shoplifting Walmart
? >	Symptoms of conception

It is nearly midnight when the last and most disturbing of these cries appears. It arrives buried between searches about seafood restaurants in San Diego, thongs, mafia cheats, and bisection bandwidth topology.

| Santa Clara, Calif. > | What to tell a suicidal friend |

This query hasn't come from Kuala Lumpur or Genoa or Montevideo, but just outside Google's front door. A drama is unfolding only a few miles away, and there is no way to help; I don't even know the person's name. I can only sit and watch the words crawl up the screen and disappear. This is a contract between man and machine, and I can only observe, not intervene.

Stricken, I glance over at Rae, who has returned from night league volleyball, his spiky blond hair still wet. He, too, has seen the query and is typing away furiously. Finally he stops and looks up at me. "They're going to be OK. They got referred to the right places."

"You can do that?"

"Yeah, well, I can see how the system responds. And if it doesn't give the right information, I'll find better sites and attach them for future queries."

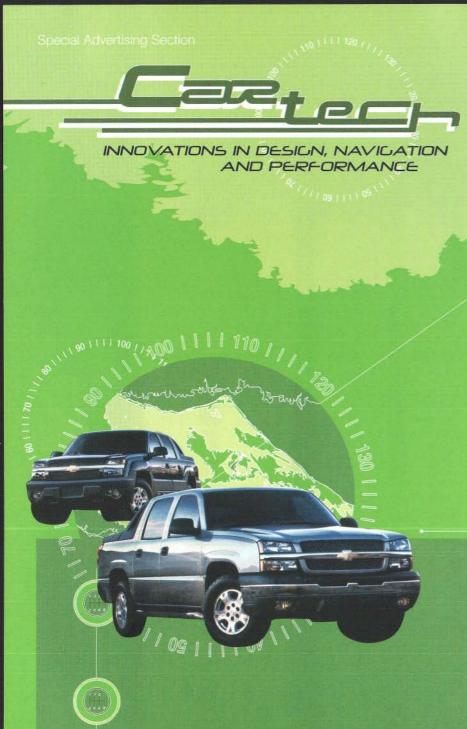"But you can't help the people who ask the original question."

"No."

"Just the ones that follow?"

Rae nods. "You've just got to do the right thing. The hard part is figuring out what the right thing is."

He thinks a moment, then gestures at the screen. "I know people trust in this thing. They believe it will have the answer. And I don't want it to fail them." As Rae talks, 50 more queries scroll up the screen.

San Jose, Calif. >	Capital of Peru
Sao Paolo, Brazil >	Jogos eroticos
AOL >	Anybody?

Michael S. Malone (msmalone@aol.com) is the author of The Valley of Heart's Delight: A Silicon Valley Notebook 1963-2001.

IT IS NEARLY MIDNIGHT WHEN THE MOST DISTURBING CRY FOR HELP APPEARS.

Car tech

INNOVATIONS IN DESIGN, NAVIGATION AND PERFORMANCE

Personalization and customization are clearly focal points for today's technology. Web sites, digital TV, even the cell phone can now be tailored to the needs of the individual. This trend is now gaining steam in one of the more traditional consumer products, the automobile.

Thanks to advanced technologies, vehicles, and the equipment inside them, are becoming much more customized to the desires of the driver. It's likely that at one point in the future, automobiles — from the outside in — will be designed for each individual driver.

The Body

We are now seeing an evolution toward this customization with trucks like the Chevy Avalanche. The interior of this automobile can transform itself, morphing from a truck to an SUV, or vice versa, in less than a minute. By utilizing the innovative Midgate, adding in replaceable glass, and proportioning the bed just right, GM's engineers have created the first vehicle capable of changing in such a way.

"It required very innovative and unique engineering to make it completely safe from the elements and have the cargo box

AVALANCHE

What do you want? SUV or pickup? Chevy Avalanche ended that debate, because this truck gives you the best of both worlds.

Chevy Avalanche settled the classic "SUV or pickup" debate with the revolutionary Midgate, giving you the best features of both vehicles. The Midgate converts Avalanche from an SUV with a 5.3-ft. cargo box to a full-size pickup with an 8.1-ft. cargo box.

Now, with even more versatility, you can choose between two very distinct styles. The classic "armor plating" gives Avalanche a distinct, rugged, adventurous look. But, if you want a lean, mean adventure machine, check out the Chevy Avalanche available sleek new exterior, Without Body Hardware (WBH) Package.

No matter which style you choose, Avalanche still gives you the same incredible innovations such as the Midgate, two powerful V8 engines, Rigid Cargo Cover and incredibly smooth ride and handling.

Discover the versatility Avalanche has to offer. This is one truck that's tough and flexible enough to keep up with you. Expect nothing less from the family of Chevy Trucks – the most dependable, longest-lasting trucks on the road.* To find out more about the rugged Chevy Avalanche, please visit chevy.com/avalanche.

*Dependability based on longevity: 1981-July 2001 full-line light–duty truck company registrations.

THIS IS WHAT YOU GET WHEN YOUR ENGINEERS GROW UP
PLAYING WITH TRANSFORMERS AND WATCHING THE A-TEAM.

AVALANCHE ◀ LIKE A ROCK

By the looks of it, they ate a lot of Pop Rocks, too. The 2003 Chevy™ Avalanche.™ It changes from an SUV to a pickup. chevy.com/avalanche

Cartech

change from an SUV with 5.3-ft of space to a full-size pickup with an 8.1-ft cargo box," says John Schwegman, Avalanche Marketing Manager.

This adaptability gives the driver a flexibility that has always been very difficult to achieve — either a driver had an SUV, or a truck, but never both. With this as a first step, it would be easy to see every vehicle's shell be configurable to a consumer's needs. Schwegman points out, "We've found that versatility and customization have become the biggest selling points in automobiles today."

Navigation

While flexible body design is a big part of greater automotive personalization, there's no doubt that navigation systems are equally important. What's more individual than telling the driver where to go and how to get there?

That's where technology from companies like Garmin comes in. This Kansas City-based company recently introduced the Street Pilot III, an advanced new onboard GPS navigation system. The Street Pilot III not only shows a digital map of the driver's area but will also verbally guide the driver to his or her destination.

"What's different with this GPS system is that it's portable," emphasizes Steve Lovell, a marketing specialist at Garmin. "You can put it into an old car, or in a rental car when you're traveling, and it will help you get around effortlessly."

Handling

The increasing consumer demand for more customization has also driven another Chevrolet product, the famed Corvette, to

Imagine an over-the-road 'co-pilot' creating a route to get you to your destination and then providing clear, accurate, voice-prompted turn-by-turn directions. This traveling companion's full-color LCD will show you locations of all the nearest highway exits, gas stations, restaurants, ATMs, hospitals, and rest areas — plus much more.

Meet the StreetPilot® III — the latest in affordable, portable satellite navigation for your car or truck. The simple, intuitive menus offer access to the shortest and fastest routes, turn directions, and estimated time of arrival at your intended destination. Along the way, the StreetPilot III provides automated voice prompts, alerting the driver to necessary turns, distance to upcoming turns, course deviation, and distance to final destination.

The StreetPilot III comes with a MapSource™ City Navigator™ CD-ROM and everything you need to download street-level maps from your PC. Then, just place the portable system on the dash of any vehicle, and enjoy stress-free driving and peace of mind — without any costly service charges or hook-up fees.

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Give *your* car the luxury of satellite navigation.

StreetPilot III

GPS V

The StreetPilot® III from Garmin has features found in expensive in-dash navigation systems, plus one very important quality the others don't have. StreetPilot III is portable, so you can have the best in GPS navigation in any car you drive. Look up addresses, attractions and other services, and StreetPilot III will create a route and provide turn-by-turn directions with voice prompts to get you there.
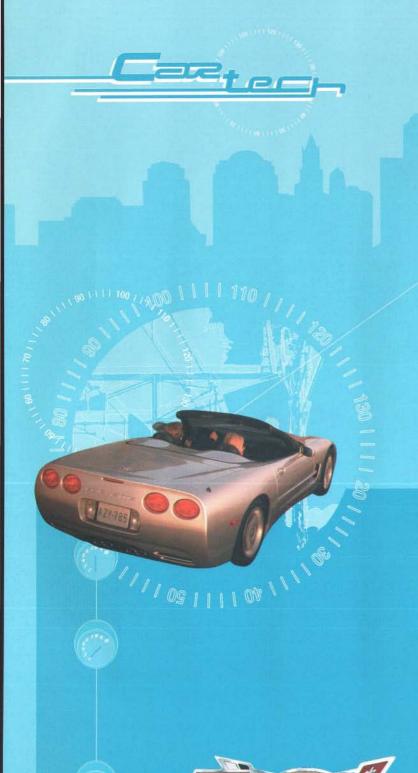
StreetPilot III and GPS V from Garmin. Navigation for every car.

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Available at: BEST BUY   city   COMPUSA

Car tech

create a unique system that could help usher in a new era in handling, with software that can give you any feel you want, whenever you want.

The Corvette's Magnetic Selective Ride Control allows the suspension and shocks in a car to adapt as driving conditions change. If the Corvette is heading into a winding road, the shocks and suspension will tighten up, providing a sportier feel to handle the curves. When it hits the open highway, the systems relax for a smoother ride.

The Corvette can provide that versatility thanks to mechanical sensors installed on the wheels, which send electronic signals to the Magnetic Selective Ride Control device. When the wheel sensors detect a bump in the road, for example, they send a specific electronic signal to the magnetic liquid that controls the suspension and shocks. The magnetic charge picks it up and then forces the liquid to soften. When the liquid softens, so do the suspension and shocks. If a stiffer feel is in order, then signals are sent to harden the liquid.

"Normally you either get a firm sports car feel or a plush, soft luxury-sedan feel, but you don't have both," says Harlan Charles, the product manager for the Corvette. "With this new system you can have the best of both."

Making a car more your own — fit for your needs and getting you exactly where you want to go. That is the future for automobiles. And these are just a few of the innovations and technologies that will get us there.

Of course the last 50 years

have been a blur.
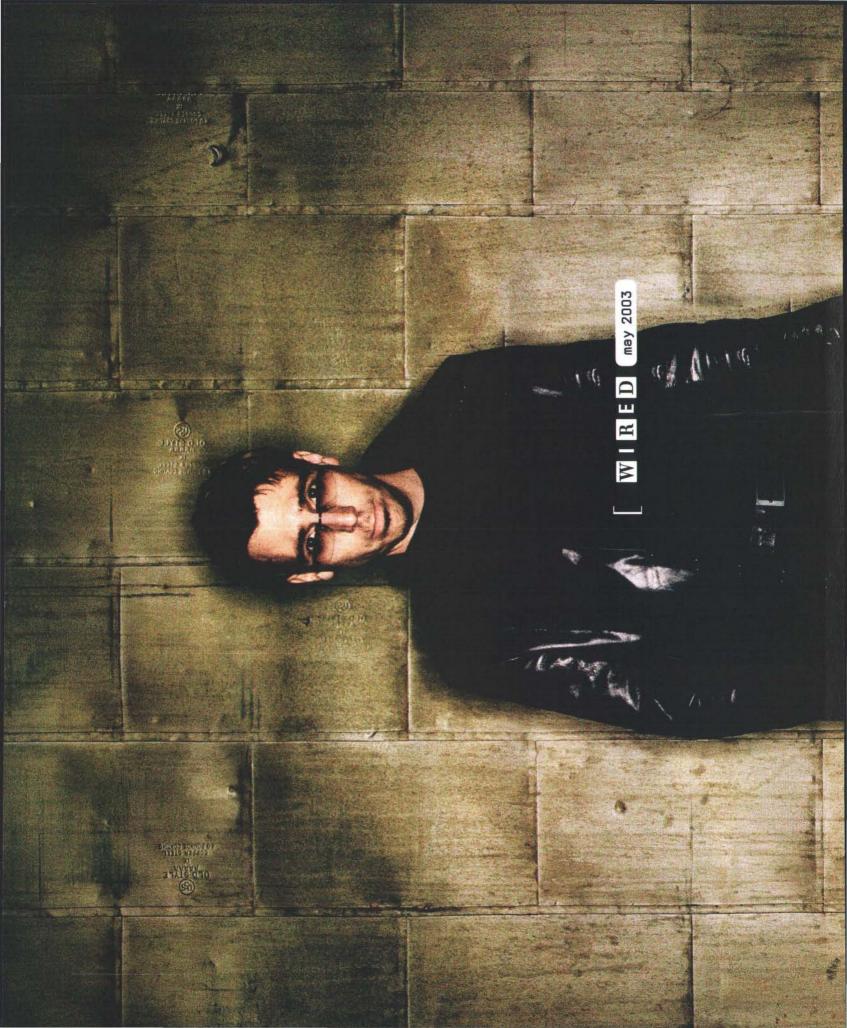
That's the whole point.

The 50th Anniversary Corvette.

CHEVROLET 50 CORVETTE

MATRIX²

[Bullet Time was just the beginning. F/x guru John Gaeta reinvents cinematography with *The Matrix Reloaded.*]

[by Steve Silberman]

[photographs by Matthew Welch]

I'm sitting in a former naval barracks

in Alameda, California, watching the digital assembly of a human face. Bones, teeth, glistening eyes. Layer upon layer. Finally the hair and skin, the creases and tiny scars that make us who we are. The face blinks and breathes. Then it snarls, and my skin crawls. Agent Smith is back, and he's pissed.

You'll be seeing a lot of Agent Smith this year. Neo's man-in-black nemesis returns on May 15 in *The Matrix Reloaded,* the continuing story of a young hacker who learns that the apparently real world is an elaborate computer simulation. In November, a second sequel, *Matrix Revolutions*, will take up where *Reloaded*'s nail-biting climax leaves off.

Things have changed since 1999. In the last shot of the original film, Neo, played by ex-slacker Keanu Reeves, flew up out of the frame, demonstrating that his mental abilities had become stronger than the enslaving delusion of the Matrix. Now he's a full-fledged superhero, soaring over the skyline at thousands of miles an hour and making a rescue as trucks collide head-on. The bad news: Agent Smith, played by Hugo Weaving, is a rogue virus in the Matrix, able to multiply himself at will. And the last free human city, Zion, in a cave near the Earth's core, is under attack.

What hasn't changed is the dark, richly nuanced aesthetic of brothers Larry and Andy Wachowski, a pair of Hollywood outsiders who wrote and directed what became the most successful movie in the history of Warner Bros. The Wachowskis had always conceived of Neo's odyssey as a trilogy, but to release both sequels months apart – plus the videogame *Enter the Matrix* and an anime series called *The Animatrix* – required a year of intense collaboration, as the scripts, sets, and shot designs all evolved together.

The Matrix raised the bar for action films by introducing new levels of realism into stunt work and visual effects. For *Reloaded* and *Revolutions*, the Wachowskis dreamed up action sequences that were so over-the-top they would require their special-effects supervisor, John Gaeta, to reinvent cinematography itself.

With four Academy Award nominations to their credit, the members of the core *Matrix* team reconvened in February 2000 at a secret location near the beach outside of Los Angeles. There – at the home base of Eon, the Wachowskis' production company – Gaeta, concept artists Geof Darrow and Steve Skroce, production designer Owen Patterson, producer Grant Hill, and the brothers brainstormed around "the most James Bond table you've ever seen," Gaeta says. Hanging above it were pulldown screens linked to

3-D workstations so that art and designs could be discussed collectively. Over the next year, a river of drawings, storyboards, and stage plans flowed into Eon's asset-management network, which was christened (what else?) the Zion Mainframe.
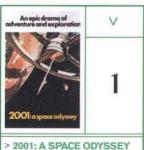
For visual ideas and inspiration, the group cranked up *Alien, 2001, Vertigo, Apocalypse Now, Koyaanisqatsi,* and *20,000 Leagues Under the Sea*, along with documentary footage of car crashes, robotics manufacturing, 19th-century submarines, glassblowers at work, the drilling of the Chunnel, the heavyweight bouts of Rocky Marciano, and the explosion of the *Hindenburg*. Madhouse, the makers of *Akira* and *Metropolis,* prepared a custom reel of explosions of various types and sizes for the Wachowskis, who were particularly interested in the ways that natural phenomena – weather, water, flames – are depicted in anime as intelligent obstacles, characters in their own right.

As the team tossed ideas around for one hellacious fight scene that became known in-house as the Burly Brawl, Gaeta realized that the innovative technology he and his crew developed for *The Matrix*'s ultra slo-mo action sequences would not be sufficient to bring the Wachowskis' new vision to the screen. Those oft-imitated shots – now universally known as Bullet Time – required serpentine arrays of meticulously aligned cameras, and months of planning, for a brief scene featuring two or three actors. In the Burly Brawl, super-Neo would battle more than 100 Agent Smiths in an extended orgy of kung fu orchestrated by crack martial-arts choreographer Yuen Woo-Ping.

To develop the technology needed for the Burly Brawl, Eon and Warner Bros. launched ESC, a visual-effects skunk works in an old naval base across the bay from San Francisco. ESC ultimately produced more than a thousand visual-effects shots for the two sequels, and the company has operated in stealth mode until now. The word *Matrix* didn't even appear on the scripts' title pages; instead, they were tagged with a code name, *The Burly Man*.

Contributing editor Steve Silberman (digaman @wiredmag.com) wrote about bacterial communication in Wired *11.04.*

So what does a visual-effects supervisor do to follow up the Matrix trilogy? Gaeta says his next project will be "some combination of *Akira*, Busby Berkeley, and *Apocalypse Now*."

For *Reloaded*'s blowout chase sequence – Trinity and a character called the Keymaker haul ass on a motorcycle to the nearest landline, past carloads of marauding bad guys – ESC constructed a quarter mile of new freeway on the naval base. Eventually, Gaeta enlisted more than 500 digital artists from a roster of cutting-edge effects vendors (including Sony Pictures Imageworks, Animal Logic, Tippett Studio, BUF Compagnie, and Giant Killer Robots) to create everything from shimmering swarms of Matrix code to thousands of vengeful robot "squiddies" burrowing toward Zion.

But the Burly Brawl became Gaeta's personal obsession. Like many in the film industry, he has been talking for years about the promise of virtual cinematography, a confluence of technologies that would allow directors to sculpt actors' performances with the ease of tweaking a CAD file. The traditional ways of doing this, however, reduce the world to the kinds of data that computers easily understand, and the result often ends up looking like a glorified videogame. That wouldn't work for the Burly Brawl, a fight that erupts in a virtual prison indistinguishable from the real world.

"People get really preoccupied with, 'Are you going to top yourselves this time? Are you really gonna come up with a *zinger*?'" Gaeta tells me. "My job has nothing to do with making zingers. The point is not to knock you over with a visual trick. The point is to be able to construct events that are so complex, in terms of what human bodies need to do, that the total 'effect' is *impossible choreography*. 'My God! It looks real, but it just can't be.'"

The showdown is set in a dingy courtyard in the vast cityscape of the Matrix. A sign on a pole says NO BRAWLING. It will not be a good day for that sign.

Neo and Agent Smith face off as crows flutter into the air. Words are exchanged. Things do not go well. The agent makes a bold attempt to load himself into Neo's body, but Neo's powers are too strong now. What Smith needs is reinforcements, a cavalry. Being a virus, there are potential recruits everywhere.

If the dojo fight in *The Matrix* was a kung fu sonata, the Burly Brawl is a symphony. Neo tears the sign from the ground and wields it as a kendo sword, vaulting pole, and battering ram. A woman walking by can't believe what she's seeing; suddenly her body is hijacked, she drops her grocery bag, and another Smith charges into the fray. Whole battalions of Smiths arrive, mount assaults, attack in waves, scatter, regroup, and head back for more. (At ESC, one massive pile-on was dubbed the "Did someone drop a quarter?" shot.) In the thick of it, Neo is dancing, chucking black-tied bodies skyward, pivoting around the signpost, and using shoulders as stepping-stones over the raging river of whup-ass.

Fans will wear out their remotes replaying the scene on DVD, but what they won't see, even riding the Pause button, is a transition that happens early on. When Neo and Agent Smith walk into the courtyard, they are the real Reeves and Weaving. But by the time the melee is in full effect, everyone and everything on the screen is computer-generated – including the perspective of the camera itself, steering at 2,000 miles per hour and screaming through arcs that would tear any physical camera apart.

This is virtual cinematography, but the most impressive thing about the Burly Brawl is that it doesn't look virtual at all. The digital faces of Reeves and Weaving could get past a flank of security guards, and the buildings surrounding the courtyard look dreary and lived-in – the grimy, unmistakable patina of the real.

Effects designers have been swapping CG faces onto the heads of stunt doubles for more than a decade, but typically, these faces were seen for only brief moments, from afar, or were occluded by other effects, like flames or smoke. Previous attempts to render faces with enough verisimilitude so that a camera could linger produced virtual visages that had a plastic, androidal quality, like the all-digital actors in *Final Fantasy: The Spirits Within*. Because the faces of Reeves and Weaving are so familiar to the audience – and because, as ESC's effects supervisor Kim Libreri puts it, "our brains are hardwired from day one to look at human faces and not be deceived" – Gaeta's job was that much harder.

The standard way of simulating the world in CG is to build it from the inside out, by assembling forms out of polygons and applying computer-simulated textures and lighting. The ESC team took a radically different path, loading as much of the real world as possible into the computer first, building from the outside in. This approach, known as image-based rendering, is transforming the effects industry.

A similar evolution has already occurred in music. The first electronic keyboards sought to re-create a piano's acoustic properties by amassing sets of rules about the physics of keys, hammers, and strings. The end result sounded like … a synthesizer. Now DJs and musicians sample and morph the recorded sounds of actual instruments.

Instead of synthesizing the world, Gaeta cloned it. To make the Burly Brawl, he would have to build the Matrix.

At the end of a desolate street in Alameda, giant cargo cranes rise out of the bay – the same towering machines that inspired the design of the Imperial Walkers in *The Empire Strikes Back*. When Gaeta and his crew moved here two years ago, there was no heat or air-conditioning, and the hundreds of bunks occupying the main building had been soaked in a

Scenes from *Reloaded*: The beginning of the Burly Brawl, above. Below center: Trinity slams the door; Morpheus in Zion; the evil Twins. Below left and right: Neo kicks ass and visits the Keymaker.

flood. Now 270 animators, painters, pyrotechnicians, rotoscopists, and coders buzz around the cinder-block rooms. The hallway between the Trinity Conference Room and the Zion Theater is lined with original prints by the resident artists, 80 percent of them eager ESCapees from other effects houses, notably Pixar and Industrial Light & Magic.

Still boyish at 37, with the scruffy elegance of a rock prodigy who has stayed relevant, Gaeta sports long sideburns that are themselves a kind of visual effect, sculpting his jawline. He speaks with an ironic inflection, elongating vowels so that when he says *"Re-loo-oaded"* or *"Revo-luuu-tions,"* the titles come with air quotes preinstalled.

Growing up on Long Island, Gaeta was a classic high school underachiever until he discovered photography and what he calls a "dark universe perfection" in the films of Stanley Kubrick and Ridley Scott. After graduating from NYU film school in 1990, he became a production assistant on *Saturday Night Live.* Then a friend told him that Douglas Trumbull – the effects guru behind *2001* and *Blade Runner* – was launching a new studio in an old textile mill in western Massachusetts. It was here, at a company called Mass.Illusion, that Gaeta met his mentors and embarked on a quest to seamlessly integrate the digital and the real.

"I was awestruck working with Doug because he was so fearless," Gaeta recalls. "He'd say, 'This camera doesn't exist yet, but we're going to make one. This screen doesn't exist, but we'll build it. Then we'll invent a new format.' Doug was innovating constantly."

Diane Piepol, a digital artist who worked at Mass.Illusion, says Gaeta was equally at home with the camera jocks and the computer geeks: "He brought more long-range technical investigation to his job than I had ever seen. Usually you have the digital people on one side and the camera people on the other, and they don't talk much. But John was fluid in both worlds."

The first step in bringing real objects into the virtual world was to obtain precise measurements of everything in the frame. To render an existing city block, CG artists would seek out blueprints of each building so they could generate wireframe models to scale. When work began on 1998's *What Dreams May Come,* Gaeta and effects supervisor Joel Hynek headed off to Glacier National Park in Montana, the setting of that film's visual centerpiece – a vision of heaven as a luminous, still-damp oil painting. At night, Gaeta hiked into the mountains with a laser-radar rig to survey the rock faces.

Meanwhile, the Wachowskis were struggling to convince Warner Bros. to green-light *The Matrix.* Action-movie mogul Joel Silver was enthusiastic about the script, but with its gnostic allegories, Baudrillardian subtexts, and Philip K. Dick mindfuckery,

it was no *Die Hard With a Modem.* To clinch the deal, the brothers hired Darrow and Skroce, two underground comic book illustrators, to draw up art and elaborate storyboards. There was one element in the script, however, that could never be adequately represented with static images: Bullet Time.

This was the Wachowskis' name for a visual effect that didn't exist yet: an action sequence that slowed time to a sinuous crawl and then cranked it back up to normal speed as the camera pivoted rapidly around it. It was the kind of challenge Gaeta had been waiting for. When he read the script, he pleaded with an effects producer at Mass.Illusion, "You have to get me this gig." Gaeta's prototype was so impressive, it got him the job, and the studio agreed to make the movie.

To make Bullet Time happen, Gaeta merged two techniques with roots in the earliest days of photography.

In the mid-19th century, another group of geeks had wrestled with the task of relating the physical to the virtual: mapmakers.

After the invention of the daguerreotype, a cartographer named Aimé Laussedat suggested stringing cameras to kites and lofting them over Paris. By taking multiple exposures of the landscape from different angles and triangulating them with clever algorithms, it was possible to generate a topographical map from flat images, similar to the way your brain generates depth perception from two separate 2-D inputs: your eyes. Laussedat's breakthrough was christened photogrammetry.

Fast-forward to the early 1990s, when another Frenchman, Arnauld Lamorlette, the R&D director for design firm BUF Compagnie, faced a problem similar to Laussedat's. Industrial clients examining buildings for structural flaws needed to see Paris from above. Parisian airspace, however, is tightly controlled; non-military aircraft may fly over the city only on Bastille Day. Lamorlette found that by morphing between two photographs, he could generate a 3-D model: digital photogrammetry. BUF employed the technique to help director Michel Gondry create a music video for the Rolling Stones. Its radical camera moves – zipping through a room full of partygoers frozen in midmotion – caused a sensation in Europe. (BUF also used this method to make a Gap ad called "Khakis Swing" that was most Americans' first glimpse of the effect.)
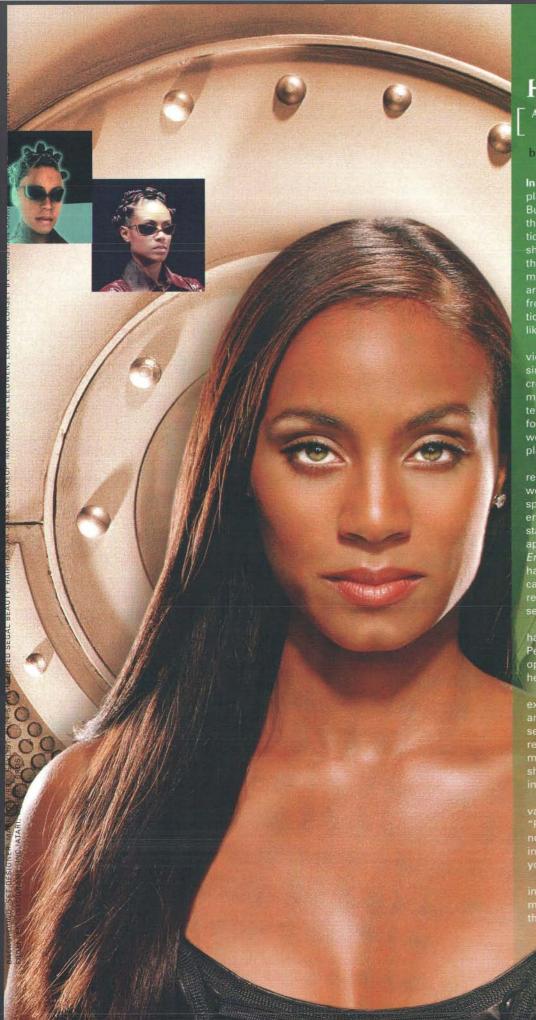
Gaeta and Kim Libreri pumped up this technique for *The Matrix:* By triggering a circular array of 122 still cameras in sequence, they were able to simulate the action of a variable-speed movie camera that tracked completely around its subject. Because the cameras located on one side of the array were visible to those on the other side, however, they also needed a way to computer-generate photo-realistic

5

6

VERTIGO: MPTV

HOW TO BE A REAL HOLLYWOOD PLAYER

[And the Oscar for Best Actress in a Supporting
Game goes to … Jada Pinkett Smith!]

by Evan Ratliff   photograph by Jill Greenberg

In *Reloaded,* the *Matrix* sequel, Jada Pinkett Smith
plays the supporting role of Niobe, a hovercraft pilot.
But in *Enter the Matrix,* the spinoff videogame, she's
the star. Both will be released on May 15 – a synergis-
tic first for Hollywood. (*GoldenEye 007,* a well-received
shooter, came out a full two years after the movie hit
theaters.) The movie industry has promised multi-
media convergence ever since Atari's *Star Wars* hit
arcades 20 years ago. But with minimal participation
from actors and directors, franchised game incarna-
tions have largely ended up as flubs that look and play
like marketing ploys.

Enter the Wachowski brothers, avid gamers who
view the two *Matrix* sequels and the game as a
single project. All three titles share the same sets,
crews, costume designers, choreographers, and –
most crucially – actors. Each of the 25 main charac-
ters in the film reprise some version of their role
for the game, and none more than Niobe. She and
weapons expert Ghost (Anthony Wong) are the only
playable characters.

While the typical spinoff might require actors to
reread a few lines or submit to a scan, Pinkett Smith
worked as hard on the game as on the movie that
spawned it. She had to memorize game scripts sev-
eral times longer than their film equivalents. She's
starring in an additional hour of the movie, which will
appear not in theaters but as cut-scene interludes in
Enter the Matrix. And to get the gameplay right, she
had to endure six months' worth of extra motion
capture, face mapping, and full-body scanning. The
result, she says, was maddening. "You had first unit,
second unit, third unit, and then the game stuff."

That's a first for videogame production. "I could
have hired some cheap actors to do it," says David
Perry, whose company, Shiny Entertainment, devel-
oped the game. "But the Wachowskis didn't want to
hear that. They were like, are you kidding me?"

For actors, shooting on a game set can be a trying
experience: Game producers have to film from all
angles to create realistic action. The motion capture
set also required pretend-driving foam-and-wire cars,
reacting to nonexistent explosions, and fleeing from
make-believe agents. "It was like being a kid again,"
she says. "Everything had to be created through my
imagination."

It wasn't easy, but the result, she predicts, will
vault game acting into Hollywood's next big thing.
"People are going to wanna be down," she says,
noting that husband Will Smith is already investigat-
ing a game tie-in for his next movie. "That's the way
you are going to have to do it from now on."

That's fine for Pinkett Smith – as long as she's work-
ing with the masters. "I know that if the Wachowskis
made another game," she says, "it would be some-
thing that's never been done before." ■ ■ ■

sets so they could paint the cameras out of the frame.

Gaeta found the answer in 1997, at the annual visual effects convention Siggraph, where he saw a short film by Paul Debevec, George Borshukov, and Yizhou Yu called *The Campanile Movie*. The film – a flyover of the UC Berkeley campus – was generated entirely from still photographs. Like the 19th-century cartographers, Debevec and his team derived the precise shapes and contours of the landscape by triangulating the visual information in still photographs. Then they generated 3-D models based on this geometry, but instead of applying computer-generated textures to the models, they wrapped them with photographs of the buildings themselves. The trick worked spectacularly well. Instead of resembling something out of *Toy Story*, the buildings and the surrounding hills in *The Campanile Movie* looked absolutely real.

"When I saw Debevec's movie, I knew that was the path," Gaeta told me. To walk that path as far as the Wachowskis needed him to go, he hired Borshukov, who had written the algorithms used to render the images at Berkeley. Borshukov, Libreri, and a visionary effects engineer named Dan Piponi became Gaeta's core posse at Mass.Illusion, a collaboration that continues to this day at ESC.

"John, Kim, Dan, and I all have this passion for sampling the real," Borshukov says. "By extracting information from the real world, you preserve all the richness and variation, the noise, the unrepetitiveness, the subtleties – the things that are so hard and

behind and around things, and to know what was obscured by any particular angle, so that if the Wachowskis wanted to try different passes through the Burly Brawl, the entire scene would already be in ESC's computers, captured in code, as real as if it was a physical set. Unlike a physical set, however, the scene would be moving – alive with the rage of hundreds of men fighting in top form. Bullet Time squared.
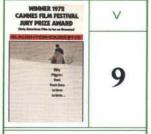
The process of creating multiple Smiths was fairly straightforward. First Gaeta and his crew turned a 250,000-square-foot hangar in Alameda into the biggest motion-capture dojo in the world. The punishment was relentless for Yuen Woo-Ping's army of black belts; between the sequels and the videogame, they did hundreds of takes a day. Buffed out with CG muscle, tailored in simulated suits, and animated with collision data obtained from digital crash-test dummies, the torsos of Yuen's warriors were transformed in postproduction into wave upon wave of attacking Hugo Weaving clones.

Then came the real work.

While the topography of the human face is the hardest to simulate digitally, it turns out to be one of the easiest to map photogrammetrically. It has fewer shadows and occlusions than, say, the city of Paris. The language of the face communicates maximum information through the subtlest inflections. The interfaces of our souls are designed to be read in a heartbeat.

To replace the faces of Yuen's men with that of Agent Smith – while retaining the level of photoreal-

INSTEAD OF SYNTHESIZING THE WORLD, GAETA CLONED IT.

expensive for computer graphics to achieve. Eventually, computer graphics will be able to build these things. We're jumping the gun by 10 years."

Creating the Burly Brawl, however, is a taller order than inventing Bullet Time. To portray Neo in hand-to-hand combat with more than 100 Agent Smiths in the old way would have required Escher-like tangles of crisscrossing still-camera rigs and years of compositing. What Gaeta needed was a virtual camera that could fly through the 3-D scene – as free from the laws of space and time as Neo is from the physical laws of the Matrix.

"The concept of Bullet Time had to graduate to the true technology it suggested," he says. "For *Reloaded*, we had to finish the job so that we could get relentless, uninterrupted, and editable chunks of Neo in the zone."

This virtual camera needed to be able to see

ism that the Wachowskis demanded – Gaeta and his team built a system for sampling the real at a higher resolution than had ever before been attempted, dubbing this process universal capture.

Gaeta began by making lo-res laser scans of Reeves' and Weaving's heads in relaxed, neutral poses. These scans furnished the basic geometry upon which succeeding layers of real-world data would be applied.

Then Reeves and Weaving each sat down on a stage in front of five Sony HDW-900 video cameras. The massive datastreams from these cameras – one gigabyte a second – were treated like holy water; even the cameras' color-correction software was disabled to prevent any loss of data. Instead of recording to tape, which requires compression, the cameras were modified to send uncompressed data to a bank of high-end PCs that stored it on a huge disk array. "The scene in that room was surreal," Gaeta recalls.

"There's this guy onstage, and his face is surrounded with this fucking *Cape Canaa-averal* backup system."

As Reeves and Weaving acted out a range of facial expressions for their rumble in the courtyard, the cameras captured each twitch of muscle and every change in the blood flow to the skin. This data was then analyzed with algorithms written by Borshukov that tracked each individual pixel as it moved from frame to frame. The tiny irregularities in the actors' faces actually made this job easier, giving Borshukov's algorithms distinctive points in space to grab on to as he reconstructed the actors' features moving through time.

The old Bullet Time rig had produced the illusion that reality was a big CAD file, but it was just an effect, not a three-dimensional world that could be

because they're transparent – a world that looks like the world.

For years, employees at ILM have joked that George Lucas is pushing to create virtual cinematography so that he can do away with living actors. It is a point of pride at ESC that its methods are designed to augment the subtleties of human performance, not replace them.

"We're not interested in making Keanu say things he hasn't said," Borshukov tells me. "Our aim was to preserve the most minute aspects – every smirk, every frown – of how Keanu made Neo real."

The ability to create photorealistic virtual human beings raises unsettling questions, especially in conjunction with the means to cut-and-paste them

"BY SAMPLING THE REAL, WE'RE JUMPING THE GUN BY 10 YEARS."

manipulated as easily as if it really *was* a CAD file. The universal-capture rig enabled ESC to smuggle the faces of Neo and Agent Smith across the border between the digital and the real, into Gaeta's Matrix – a zone where skyscrapers, skin, flames, and marauding machines are all re-created equal.

What this means for moviemaking is that once a scene is captured, filmmakers can fly the virtual camera through thousands of "takes" of the original performance – and from any angle they want, zooming in for a close-up, dollying back for the wide shot, or launching into the sky. Virtual cinematography.

How deep did the rabbit hole go? A cast of each actor's head was sent to a company called Arius 3D, makers of ultrahigh-resolution scanners employed in 1999 to archive the works of Michelangelo. The Arius scanner is accurate down to 25 microns – the diameter of a mold spore. To get the clothing simulations just right, ESC sent swatches of Reeves' black cassock and Weaving's jacket to a company called Surface Optics, which builds devices to measure a property of light called the bidirectional reflectance distribution function. Surface Optics happened to have one machine on hand scheduled to ship to Lockheed Martin a month later, where it was to be assigned to its usual task: evaluating the reflectivity of paint on stealth bombers.

This ocean of information – combined with even more real-world data about the light levels on the set – was poured into the rendering program of choice at ESC: mental ray. (The German firm that created it won an Academy Award for technical achievement in March.) What emerged is real enough to fool Morpheus: effects that are mind-blowing precisely

into any landscape. These questions troubled Gaeta himself so much that, a few years ago, he wrote a letter alerting President Clinton to the fact that such technology could be used for purposes of mass deception. (The letter was never answered.)
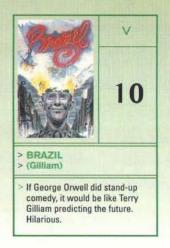
As it happens, one group deeply interested in the new breed of hyperrealistic CG is the military. Darpa is fast-tracking image-based rendering and lighting for use in immersive battle simulations. In 1999, the US Army launched the Institute for Creative Technologies at USC, where Paul Debevec – Borshukov's former mentor at Berkeley – is now the head of graphics R&D.

Gaeta recognizes the paradox. "You have these paranoid films about the Matrix depicting how people are put in a mental prison by misusing this technology, and you have the military constructing something like the actual Matrix. Or maybe *our* technology will become the actual Matrix, and we have inadvertently spilled the vial of green shit out onto the planet."

Neo and Gaeta have something in common. In a world of seductive illusions, they became revolutionaries by championing the prodigious chaos of the actual world. It's a role Gaeta accepts with a healthy dose of Wachowskian irony. Before I leave ESC headquarters, I ask Gaeta where the brothers got their codename for the film.

"*The Burly Man* is the title of the script on Barton Fink's desk. We all loved that movie," he explains. "The lesson at the end of it is that after all these ordeals, all this agony, you finally arrive at the culmination of your entire life's work – and it's a wrestling picture.

"That's what *The Matrix* is." ■ ■ ■

V

10

> **BRAZIL**
> **(Gilliam)**

> If George Orwell did stand-up comedy, it would be like Terry Gilliam predicting the future. Hilarious.

V

BONUS PICK
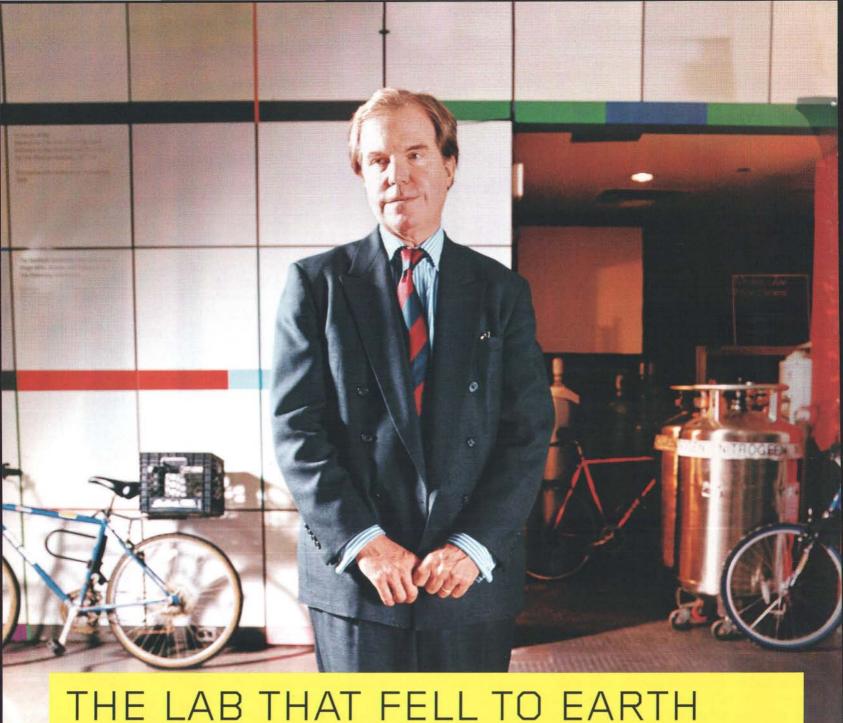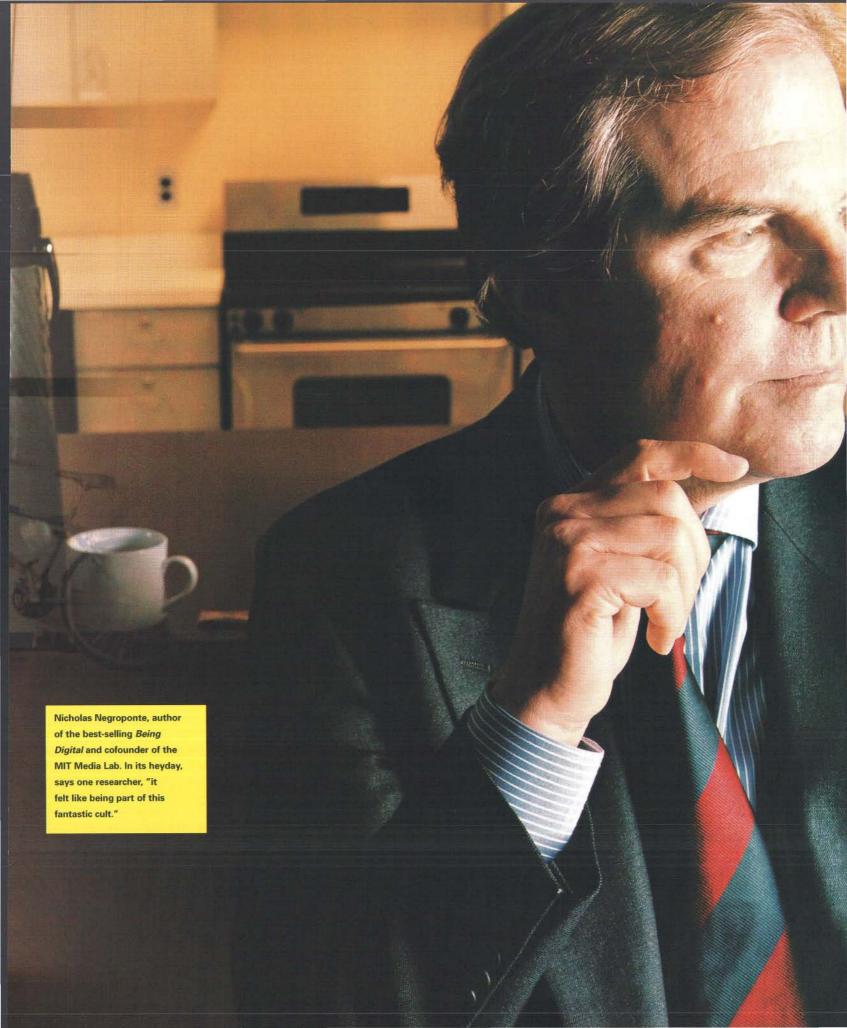
> **THE OMEGA MAN**
> **(Sagal)**

> I threw this film into the mix because it seems relevant right now. Gun freak number one, Charlton Heston, plays the only uncontaminated man left standing after a biological attack on America. Observe as he "deals" with the protests of the germed-up mutant citizenry. Has Dick Cheney seen this?

THE LAB THAT FELL TO EARTH

ONCE THE CENTER OF THE TECHNOLOGY RESEARCH UNIVERSE, THE STORIED
MIT MEDIA LAB IS NOW TEETERING ON THE BRINK OF BREAKUP – OR, EVEN
WORSE, IRRELEVANCE / BY BRENDAN I. KOERNER / PHOTOGRAPHS BY SUSANNA HOWE

Nicholas Negroponte, author
of the best-selling *Being
Digital* and cofounder of the
MIT Media Lab. In its heyday,
says one researcher, "it
felt like being part of this
fantastic cult."

THE VACANT lot on Ames Street should have been teeming with cranes and cement trucks by now. Situated on the eastern edge of the Massachusetts Institute of Technology campus, the property is earmarked as the future home of the MIT Media Laboratory, which long ago outgrew its I. M. Pei digs next door. First announced in 1999, the planned $115 million, 197,000-square-foot complex was supposed to open this year. The date was later rolled back to 2004, then 2005. Now it's officially on hold. The Lab's brain trust won't even hazard a guess as to when the first girders might rise.

So as the rest of MIT undergoes a $1 billion wave of construction, including a typically zany Frank Gehry building down the road, the Media Lab's fallow lot remains a testament to lean times at the research institute-cum-futuristic romper room, which grew out of the School of Architecture and Planning and into public consciousness during the tech boom. No donor has stepped forward with the $30 million necessary to secure the all-important naming grant for the lavish facilities. The Lab's charismatic and famously sunny founder, Nicholas Negroponte, is working the corporate circuit hard, looking to add that last crucial sum to the $75 million already in the bank – and he's sweating a bit. "The urgency to build it is much more about morale than anything else," he says. "If it's delayed another year, it would be very discouraging."

Not long ago, Negroponte seldom thought about where the Media Lab's next million dollars might come from. Throughout the '90s, the Lab was awash in funding from corporate sugar daddies eager to be associated with the vague and not exactly grammatical mission statement: "Enabling technologies for learning and expression by people and machines." This was the place, 16 years ago, that Stewart Brand immortalized in *The Media Lab: Inventing the Future at MIT*, a 250-page valentine to half-mad geniuses who would reinvent music, movies, even voicemail. As the researchers gave birth to the MPEG digital compression standard, Lego's "programmable bricks," chip-studded vests, and smart refrigerators, the organization swelled into a behemoth with a $40 million annual budget and nearly 280 researchers and professors. It also expanded into more hard-science disciplines: The multimedia jocks were joined by specialists in quantum computing, MEMS, and biomolecular machines.

The Lab's deft touch with the press certainly didn't hurt. Its professors had a knack for distilling complex notions into easy-to-digest sound bites. Negroponte himself was always ready with a frank prediction on the obsolescence of fax machines or the end of primetime TV. Many of the Lab's niftiest gizmos and ideas were featured in the early days of this magazine, which Negroponte had a hand in founding. Whenever *Details* or *Esquire* needed a mediagenic geek for a Leaders of Tomorrow spread, their photographers made a beeline for 20 Ames Street. The net effect: Negroponte's Media Lab transcended geekdom and wormed its way into corporate boardrooms and popular culture. "People always come up to me and say, 'You

don't know how talking to you changed the way we think about digital satellites!'" boasts Negroponte.

Today, those groupies might follow up their accolades with a gloomy query: "So, is the Media Lab going to make it?"

The house that Negroponte built is dealing with a nasty postboom hangover. Corporate donations once accounted for 95 percent of the Lab's budget, with much of the booty coming from thriving sectors like telecom. Now the struggling companies of the world are, needless to say, no longer as liberal with their loot. The Lab's techno-optimism and demo-centric approach to R&D has fallen out of favor. Like many private-sector startups, it has responded with belt-tightening, layoffs, and lots of rhetoric about alternative funding. One look at the vacant lot next door, though, and it's obvious the crisis isn't over.

Even worse, the financial shortfall is dredging up long-festering issues. When times were flush, no one rocked the boat. Now the hard-science groups are bucking for independence, claiming that the Lab's art-meets-technology focus is passé. Students complain that egocentric professors are undermining the Lab's interdisciplinary spirit. And the Lab's reputation as a scientific lightweight – "all icing and no cake," as Negroponte sums up the rap – never seems to die. Designing props for the wacky Flying Karamazov Brothers juggling troupe isn't exactly what the Nobel committee is looking for.

In the face of these challenges, the research center is pursuing an ambitious international expansion plan to establish beachheads in Europe and Asia. It's a curious move for an organization that, by its leaders' admission, is distended after a decade of nonstop growth.

Even if the outposts flourish, there's an increasing sense around Cambridge that the Lab needs to be rescued from irrelevance – and that once the upheaval has run its course, there will no longer be a Media Lab as we know it. Walter Bender, director since 2000, knows that changes are afoot, but he has faith that the Lab will turn the corner. "Marvin Minsky once said, 'Never trust an idea that's more than 20 years old,'" Bender quips, referring to one of the Lab's founding fathers. "Nicholas came up with the idea for the Media Lab in 1978, so we've passed the Minsky threshold. And it's still a good idea."

BENDER IS a sneakers-and-Dockers guy with a habit of fiddling with the drawstring on his office Levolors as he talks. He's been at the Lab since the beginning, lurking in the shadows of his more flamboyant colleagues. Like several other Lab pioneers, he was an odd bird at the staid Carter-era MIT – a creative type without a doctorate. For years, he quietly headed up the Electronic Publishing group while the founding troika of Negroponte, Minsky, and Seymour Pappert became synonymous with the place.

Negroponte dreamed up the Lab with the late Jerome Wiesner,

Contributing editor Brendan I. Koerner (koerner@newamerica.net) wrote about Sky Dayton in Wired *10.10.*

who served as MIT's president throughout the '70s after a stint as chief science adviser in the Kennedy administration. The pair viewed the Lab as a bold experiment in interdisciplinary research, a unique opportunity for computer scientists and graphic designers to pow-wow on the problems of tomorrow. Two years after research began, the Pei building opened with a handful of faculty members. But growth was swift under Negroponte's stewardship. Over its first decade alone, the annual budget grew by 30 percent each year.

Bender's chief assignment, by contrast, is to crack the fiscal whip. Unlike other university research entities, the Media Lab has relied almost solely on corporate money: Currently 125 sponsors each kick in a minimum of $200,000 annually, entitling them to license any Lab invention royalty-free and consult with the faculty at whim. In the halcyon days, that was good enough. Company executives happily camped out in the Lab on the off chance that a professor's random brainstorm might have the whiff of IPO about it. Now that corporate excess is out of vogue, sponsorship is a tougher sell. Stung by the telecom sector's demise, a Lucent or a Nortel is now loathe to sponsor the quest to build a "conversational humanoid," a current project in the Gesture & Narrative Language group. "Those companies are fucking dead," says one especially blunt Lab professor. "Where do we get the money from now? I don't know."

Which makes Bender's pitch to any remaining prospective funders all the more important. In his search for money, Bender stresses the facility's usefulness as a consultancy. He's fond of an anecdote concerning some software solutions the Lab designed for transferring video files to floppy disks. "John Scully found it sufficiently interesting that he planted a seed at Apple," says Bender. "It eventually got them to launch their QuickTime product. Some of what the Lab does is more to influence thinking than influence products."

Bender won't, however, offer investors the ability to direct proprietary research. No sponsor can tell the Lab what to work on or prevent another sponsor from perusing the same data. A few million dollars will buy a company entrée into the Lab's equivalent of a Gold Circle membership, giving it a bit more of a say. Still, the Lab is wary of doing research on anyone's behalf, and the intellectual property rules are more or less written in stone. "We'd sooner shut down than end up being an applied shop," insists William Mitchell, the longtime dean of MIT's School of Architecture and Planning and newly appointed head of the program in Media Arts and Sciences, which supervises the Lab's academic component.

Mitchell fears that industry meddling would prevent the Lab from tackling the sorts of problems that don't have immediate financial payoffs. As Bender likes to point out, MPEG was once deemed mere ivory tower wankery. The policy ensures that professors and researchers can continue to work on such projects, but it also leaves Bender a bit hamstrung in the race for funding. Carnegie Mellon, Georgia Tech, USC, nearly every University of California campus –

all now boast research groups that are obvious Media Lab imitators. The difference is, they're not as dogmatic about applied research, and they're benefitting because of it. When the seven major movie studios needed someone to test e-distribution models, for example, USC's Entertainment Technology Center was only too happy to take the assignment. Intel sponsors "labettes" at UC Berkeley and elsewhere. The chip king is hardly a stern taskmaster, giving only the most general directions to faculty. Much of the work is released open source, and wild tangents are encouraged.

Part of the Media Lab's funding slack has been taken up by government grants from the likes of the National Science Foundation; a quarter of this year's budget will come from Uncle Sam. But there have also been major cutbacks. After laying off 29 staffers in late 2001, Bender went after "our burn-rate problem." First-class flights and limos are out, as are free snacks at meetings. Wages for undergrad assistants have been slashed, and grad students are allowed only one out-of-town conference per year.

Bender desperately wants to retain the support given to graduate students – free tuition and a generous stipend. The whole package costs the Lab upwards of $75,000 per student per year. He calls the subsidies "a sacred cow." But Negroponte is less certain: "I've pushed hard to preserve the support – even if your name is Rockefeller, we take care of your tuition and pay you a salary. But I don't know if we can keep doing that forever."

Another professor is even more candid: "Will the days where the grad student has to pay nothing endure? No. They've been busted from landed gentry to bourgeoisie."

The austerity measures may help stop the bleeding, but they've done little to prevent the Lab from starting to splinter – a symptom of problems that extend deeper than finances. Three years ago, there was a plan to reorganize the Lab into three subdivisions: one dedicated to education and "edevelopment," one for hard science, and one for the arts. Though semiautonomous, each center would still fall within the Media Lab hierarchy. That plan is now stillborn, but the hard-science wing is nonetheless nearing escape velocity.

If the nascent Center for Bits and Atoms were to split off now, of its own accord, it could prove damaging to the Lab. "The Media Lab has really had no internal structure, largely by choice," says Neil Gershenfeld, head of the Physics and Media group and a driving force behind the hard-science exodus. "But once you get up to something that's this big, it doesn't really work anymore. The natural evolution is for more manageable chunks to emerge from it."

AS ADMINISTRATORS in Cambridge debate ways of streamlining, the Lab is pushing forward with its overseas expansion plans. Negroponte has had international aspirations since the late '80s, when the Lab bandied about the idea of opening a research institute in Japan. Eventually, Ireland was selected to host the first offshoot

– Media Lab Europe – after the Irish government offered $30 million in startup cash and an attractive 10-year lease on the Dublin warehouse that once housed the Guinness brewery's souvenir shop. Ireland's ruling party envisioned the center as the future anchor of the Digital Hub, a Silicon Alley on the banks of the River Liffey.

Nearly three years after MLE opened its doors, however, the Digital Hub has attracted few tenants. That's because the idea was flawed from the start, according to John McCormac, an Irish tech entrepreneur whose latest venture is WhoIsIreland.com. "There are a lot of smart people working there, but the logic of trying to cluster companies around the Digital Hub is questionable," he says. "Living in Dublin is expensive, and the infrastructure isn't exactly brilliant." Startups don't see the benefit of paying steep rents to bask in MLE's glory. And no "telephone tooth" – one MLE project, a molar implant that allows you to receive calls – can convince them otherwise.

MLE has attracted impressive sponsorships from Orange and Ericsson, but there have also been disappointments: 360networks dropped out, the Lab is falling short of its annual $10 million funding target, and director Rudy Burger resigned last November. The MIT spin on his departure: Burger was a strong fund-raiser, but the time had arrived for a more nuts-and-bolts type to take charge.
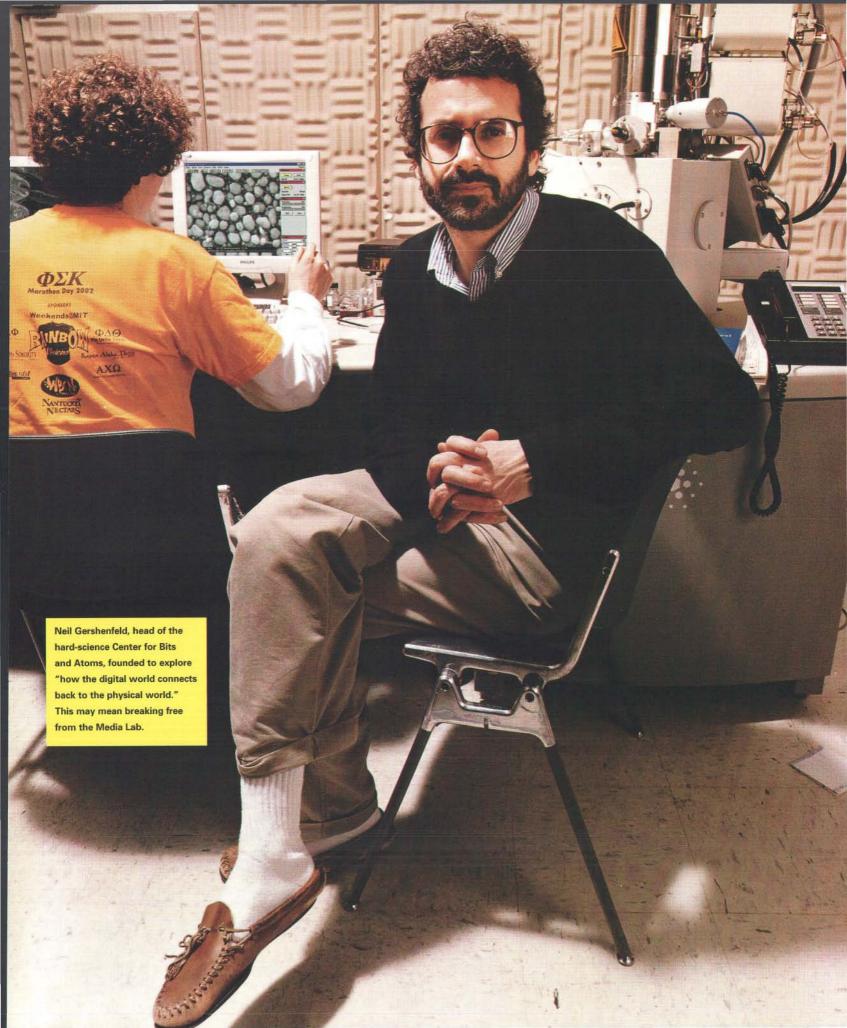
Even the official explanation begs the question: Take charge of what? It's almost impossible to decipher the MLE's long-term purpose. Bender says simply that "different cultures have different things to teach us." Mitchell speaks of a need to create "intellectual free-trade zones." The real answer may be a simple matter of economics. As Negroponte admits, more Labs mean more money.

Once rock stars, the Media Lab crew has become a geezer rock band – Lynyrd Skynyrd with pocket protectors. When the home crowd thinks you're a dinosaur, tap the international venues. And why not? Foreign nations are lining up. Media Lab Asia, headquartered in Mumbai, is slated to "influence profoundly the quality of life of the common man," says one Indian government report. The 10-year master plan calls for a total budget of nearly $1 billion, a fifth of which will be provided by the Indian government. One of the first projects is to bring Wi-Fi connectivity to rural villages.

Australia and Brazil are next on the list, and possibly Singapore. Each government wants to hop on the bandwagon for different reasons – boosting business in Ireland, alleviating poverty in India. "In the case of Singapore," Negroponte says, "the agenda is to get more young people to think outside the box, to be more contrarian."

BACK IN Cambridge, the Lab's plight has inspired some not-so-subtle schadenfreude in the hallways of MIT. While most professors labor in obscurity, Lab employees have enjoyed a warm relationship with the press. "Oh, sure, we get endless flak," laughs Mitchell, who ran the architecture school for 11 years. "A lot of people here think what we do is soft, fuzzy, unrigorous, all those kinds of things."

7 WONDERS OF THE MEDIA LAB WORLD

	INNOVATION	YEAR	INNOVATOR	DESCRIPTION
1.	Programmable bricks	1987	Epistemology and Learning group	Tiny, portable computers embedded inside Legos; makes it possible to build a "smart" Lego vehicles and creatures.
2.	Yo-Yo Ma's hypercello	1991	Tod Machover and Neil Gershenfeld	Sensor-laden instrument that responds to small movements in Ma's bow and synthesizes music accordingly.
3.	Wearable computers	1992	Human Design group	Chip-studded vests and eyeglasses, personal wireless LANS.
4.	*Being Digital*	1995	Nicholas Negroponte	Best-seller that predicted the breakdown of prime-time TV and the advent of info-rich games.
5.	Structured audio	1998	Machine Listening group	Standard to transmit high-quality sound via the Internet. Led to MPEG-4.
6.	Electronic ink	1998	Joseph Jacobson	A thin, inklike film, composed of millions of microcapsules, that can be altered with an electric charge. Works with regular paper.
7.	Blogdex	2001	Cameron Marlow	Popular weblog diffusion index tracks what bloggers are chatting about and ranks topics by popularity.

Neil Gershenfeld, head of the hard-science Center for Bits and Atoms, founded to explore "how the digital world connects back to the physical world." This may mean breaking free from the Media Lab.

Much of that reputation stems from Negroponte's punditry, especially the predictions that peppered his bestseller *Being Digital*. He was right about quite a bit – the untethering of data, the genesis of the digital video recorder. But there were also the outré prophecies about pill-sized computers that will diagnose illnesses and Barbie dolls that will go online to order new dresses. Crowd-pleasing stuff, but easy targets once the luster wore off technology's star. Britain's *The Register* now adds snarky quote marks to the phrase "technology expert" when reporting on Negroponte's latest flight of fancy.

To be fair, other Lab alums and personnel took even more outlandish stands. In 1997, Danny Hillis, a Lab graduate and founder of Thinking Machines, was touted in a *Los Angeles Times* Q&A as a biotechnology guru. Among his predictions: Telephones would be farmed, cabbages manufactured, and trees modified to produce kerosene. The performance earned Hillis the Technoquack of the Month award from the hype-busting *Crypt* newsletter and bolstered the Lab's reputation for goofiness.

The Lab is sensitive about the cream puff stereotype and tries to gloss over projects that are ripe for lampooning. On my first tour, I'm hustled past the mock kitchen where the Counterintelligence group plays around with smart dishwashers. Yet even the more serious segments occasionally feel like sound stages, arranged to cater to roaming corporate guests. Each of the 33 research groups, from Synthetic Characters to Context-Aware Computing, works beneath black signs that offer plain-English explanations of their goals for the benefit of visitors. As I mill about, I find it nearly impossible to avoid bumping into contingents from MasterCard and Motorola moving from station to station before an afternoon funding pitch.

The centerpiece of this research-in-a-fishbowl environment is the demo, the cutesy embodiment of a group's work. Wonder what the Tangible Media folks are doing? Here, play with the glass cones; they ring when placed atop a lighted surface. The Toys of Tomorrow group? Check out the programmable Lego bricks. Curious about the music front? Tap a "beatbug" and watch a corresponding video of Scottish kids weaving them into a mini-symphony. "The technology demo is the greatest invention to come out of the Media Lab," says one prominent recent graduate. "Occasionally, a demo evolves into a working product, a finished art piece, or a widely used technology. But the real product of the Media Lab is the demo itself. The demo is what gets sponsors, reporters, and the general public excited."

Mitchell doesn't exactly object to the notion. "To some extent, what we do is a mixture of research and performance art," he says. "One way to look at the demo is as a piece of performance art." Throwing in a plug for the new Fumihiko Maki-designed building, he adds, "And you need the best stage possible for that art."

The constant pressure to impress sponsors occasionally wears thin, though. One student satirizes the demo culture as a "science fair, sing for your supper" annoyance. "There were some days during the

dotcom heyday when five groups of people came through, and it was like we were playing musical chairs," says Chris Schmandt, the Lab's speech synthesis expert. "It got sort of old, spending more energy raising money than actually doing research."

So now that the demo circus has calmed down, is Lab life better? Schmandt grins. "We can only wish we were back in those days. We were all rolling in cash."

NEGROPONTE IS a tough man to track down in person. With homes in Switzerland and Greece, he spends 75 percent of his time away from Cambridge. After several terse question-and-answer sessions via email, he agrees to meet me at New York's Waldorf-Astoria. Not that he's technically violating Bender's edict against first-class travel: Negroponte is crashing with his brother John, the UN ambassador, who lives in the hotel's penthouse.

Over breakfast, I mention Gershenfeld's prediction that the Lab will be broken into "manageable chunks." I'm wondering whether Negroponte considers it sensible or heretical. He offers his characteristically positive spin. "You've got biotech and opera in the same building," he says. "It has gotten too big. It may be time to break into smaller pieces."

When the Lab came up with the three-center reorganization in 2000, the idea was for it to be formally introduced once the new building was complete. But with construction on hold, so too is the overhaul. As it is, 20 Ames Street is overflowing; five professors have been exiled to a corporate tower by Kendall Square. That's a big change from the early days. "It felt like being part of this fantastic cult," says Judith Donath, head of the Sociable Media group. Today, a researcher working on a robotic DJ doesn't know what the nanotech folks down the hall are doing until *The Boston Globe* runs a story.

Negroponte has no problem railing against bloat. "We went from the lunatic fringe to the establishment, and may have done so too fast," he says. "Being the establishment is no fun." But he lacks the pull to change much in Cambridge. He's rarely in the building; doctoral students count themselves lucky when they catch a mere glimpse of the Dear Leader. Negroponte acknowledges that he's not much of a physical presence: "I was walking Michael Douglas around the building one day, because I went to school with him. And one person said, 'Who's that with Michael Douglas?'"

The official line is that, after 17 years as the Lab's director, Negroponte felt it was time for a change and stepped down in 2000. Another take is that he lacked the bureaucratic chops to shepherd the Lab through the requisite cutbacks and downsizing. "Nicholas' attention span – and I mean this in a good way – can be very short," says Donath, trying to explain Negroponte's expansionist yen.

As money poured in throughout the '90s, Negroponte opened the Lab's doors to hard-science research groups such as Ike Chuang's quantum-computing unit. What Chuang's work has to do with the

intersection of technology and the humanities – the Lab's forté – is anybody's guess. "The physics groups really changed the tenor of this place," says Glorianna Davenport, chief of the Interactive Cinema group. "How are researchers looking at DNA sensors going to sync with someone who loves making movies and telling stories?"

No one is more sensitive to that disconnect than Gershenfeld. He has patched together the Center for Bits and Atoms, a collective dedicated to the rather open-ended question of "how the digital world connects back to the physical world." Its 20-member faculty comes from across the MIT spectrum: physicists, biologists, and the nerdiest Media Labbers. The exact nature of CBA's relationship with the Lab is yet to be determined, but it's clear that Gershenfeld craves considerable autonomy, if not outright independence. "We no longer easily fit just within the Media Lab," he explains. "It's too much of a stretch to hope for a single academic program that easily encompasses molecular biologists and graphic designers."

Whether natural evolutionary step or Gershenfeld vanity project, the CBA is obviously ready to leave the mothership. Funded by $14 million in NSF seed money, the CBA-affiliated groups are clustered in a single hallway behind a glass door bearing the center's name. While other Lab groups tinker away on standard workstations, CBA students fabricate complex circuitry on million-dollar machines – and non-CBA students grumble about being denied access to the center's servers. Gershenfeld's business card is not the standard Technicolor version proffered by other Lab staffers, but a new design that labels him the CBA's director.

And others seem to be following Gershenfeld's lead. Some artistically inclined groups, such as Tod Machover's Opera of the Future, are kicking around the notion of creating a Center for Arts and Invention, to be funded in part by the National Endowment for the Arts. Kent Larson, who heads a team delving into smart homes, talks of creating the Center for Proactive Health, which would include researchers not only from other departments but from other universities, too. With the buzz of defection all around him, Gershenfeld imagines two possible futures. In one, the Media Lab remains in perpetuity, continually spinning off groups like CBA. In another, the Media Lab is recognized as the product of a historical time and place and goes away – replaced by the new entities it gave birth to. "Nobody knows which is going to happen," Gershenfeld says.

That includes Negroponte. "We're going from a republic to a federation. I don't want to liken myself to de Gaulle, but we need to have a federation, and I guess the model we're most similar to is Switzerland." That said, Negroponte is careful to downplay Gershenfeld's rebellious streak. "There's going to be tension, because Neil is the kind of guy who likes things in black and white. Which is why I'm always saying, 'Neil, cool it.' I tell him, 'You're Liechtenstein. You may share the same money, the same army, but you're separate.'"

Despite the political bickering, Negroponte remains optimistic when considering where the Lab will be in five to ten years. "The endgame is an academic department with multiple labs, under whatever name," he says. "I'm not sentimental about the Media Lab name. I'd be thrilled to see it morph into something else. Whoever makes up the next word, it'll be their baby, and we'll be supportive of that."

BY THAT time, though, Negroponte may no longer be around to offer approval. He seems inexhaustible but inevitably will fade to a life of skiing the Alps, and a younger crop of personalities will come to embody the Lab. By most accounts, the leading candidate to assume his position as the Lab's public face is John Maeda.

An artist widely feted for his mannered digiscapes and books such as *Maeda @ Media*, the 36-year-old Maeda shares Negroponte's healthy sense of self-esteem. But that's where the similarities end. Unlike Negroponte, who didn't get involved in day-to-day student life, Maeda pays close attention to the details in his Aesthetics + Computation group. As a Media Lab dropout, he hardly embraces its often criticized model of encouraging students to work solely on projects that help their advisers get tenure or fame. Instead, he lets the students work on whatever they please. "My job is to protect them from the politics of the place, and to try and get them to work harder," Maeda says. He also dreams up innovative ways of snagging extra funding; the group recently sold a pair of antiquated air-traffic control monitors on eBay and invested the proceeds in a bevy of new iMacs.

As it turns out, the man who Negroponte, Bender, and others are counting on to keep the place glued together is hardly the type to wave the MIT pom-poms. In fact, he doesn't show much fondness for the Media Lab beyond an affinity for its art-meets-technology ideals. At an MIT symposium in 2000, he blasted an audience member who referred to the Lab as "the place where renaissance painting and polymer science overlap." "Not true," Maeda responded. "That is a typical misperception of the world from the Media Lab's perspective. I believe that things are changing, and MIT will lag behind everybody. Art and design schools are going to take over."

So what if the Media Lab was to magically disappear, I ask Maeda. How would it affect your work, your career? He seems puzzled by the question, then offers a sort of verbal shrug. "I can do it all myself if I have to," he says. "I could go and be a Japanese cook."
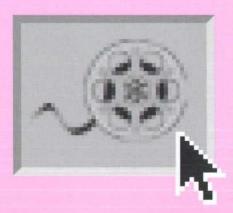
If, as the Lab veers toward do-or-die circumstances, it needs a bundle of charisma and energy to guide it back to celebrity, Maeda hardly seems the man for the job. For all the acclaim he's received in Chelsea galleries, he'll never be the palm-pressing, frontman Negroponte was. Which is why Negroponte, to his own chagrin, just can't escape the Lab limelight. "I spend a great deal of time trying to recede into the background," he sighs, "but people say, 'No, no, no, you have to be our leader!'"

But that's not in the cards. Negroponte started the Lab; someone else will have to see to a rebirth. ■ ■ ■

To Live and Die in L.A.

Information leaks, bid-rigging, pumping and dumping.
Just another day inside the secret network that will
make or break you in Hollywood.

by Ben Mezrich
photographs by Carlos Serrao

I'm at a party, and it's as crowded as it is glamorous. Elbowing my way to the balcony for a breath of fresh air, I gaze down at the unreal scene below:

fur coats draped over pink tank tops, sable hoods dyed to match, Gucci boots with impossibly high heels, designer cell phones in waterproof holsters, pashmina scarves, sunglasses hanging from platinum straps. Nobody seems to care that it's 30 degrees outside, with a stiff wind sweeping down from the mountains. There's enough star power here to keep everyone warm: Matt Damon, Tobey Maguire, Kate Hudson, J.Lo, Ben Affleck.

"Welcome to fucking Sundance," somebody next to me says. I turn to see Dana Brunetti, who's also watching the crowd. Brunetti is a producer with TriggerStreet.com, Kevin Spacey's production company. He's the reason I was able to get past the black-clad goon at the door.

The truth is, I don't belong here. I am not a Hollywood player. I am a writer from Boston, a novelist and occasional journalist. Over the past few years, like a million other struggling writers out there, I have chased the dream of breaking into the movie business. I've collected hundreds of rejection slips from agents, producers, and studios. Recently, all this changed. I wrote an article last year called "Hacking Las Vegas" (*Wired* 10.09), and the next thing I know I'm being approached to turn it into a movie starring Spacey. (We're in the very early stages of negotiating a deal.) I want to believe that Hollywood sat up and took notice of my talent and hard work. But I've heard rumors that have made me question my confidence – whispers of a dirty little

industry practice that has brought me here to Utah on a mission both personal and journalistic.

I've been tipped to the network of semi-secret cyberhallways, called tracking boards, that are open only to the most elite power players in the industry. In simplest terms, these boards are sophisticated chat rooms and BBSes where high-level executives at various studios trade information about potential projects.

They may seem innocuous at first glance, but the boards are where a writer meets his fate. Before a script goes out, it either gets deep-sixed or hyped up. Often, it's said, execs will go online and leak privileged information or even lie about projects in order to drive prices up – or down. If the rumors are true, it means that the fix is in: major collusions between studios, arbitrary blackballing, a system that mocks any standard of fair play. It's not just scripts – books, directors, even actors are tracked.

I need more than rumors, so I have arranged a rendezvous with a tracker. She's here, wedged between two frumpy screenwriters and a director with a shaved head. She's a tall, striking brunette with pouty lips and oil spills for eyes. As I approach, she shakes free and beckons me toward a quiet alcove near the coatroom.

"If you use my name," she says by way of a greeting, "I'll have lawyers all over you." She knows why I asked for the meeting. She's talking to me as a favor to Brunetti, but she's defensive. She's an exec herself, a

director of development at a studio synonymous with Oscar-quality fare. She – and people like her – control the purse strings that make movies possible.
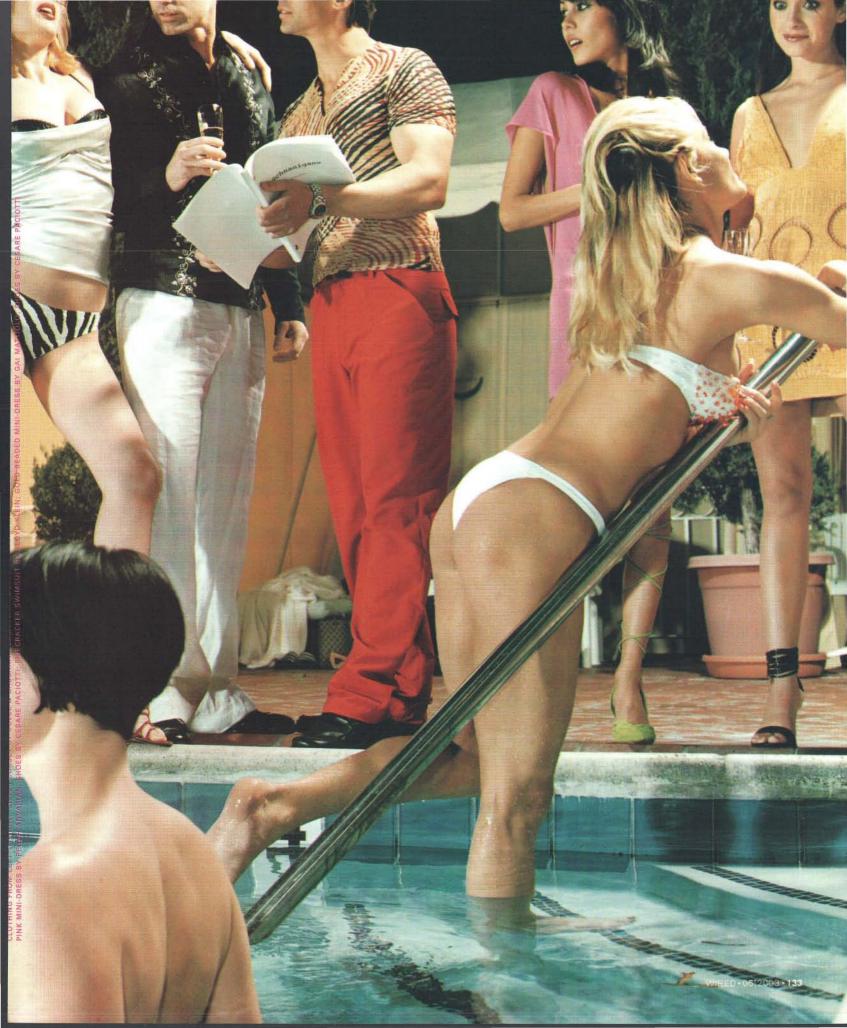
"I'm not kidding," she continues. "I could get fired for talking about this."

She takes a breath, then plunges in. "Bottom line," she says, gesturing to the scene around us, "all of this starts with the boards. You've heard of the herd mentality, right? How no decisions in Hollywood are made independently? A project that's interesting to one studio is interesting to all studios; likewise, a project with one detractor is dead with everyone. Well, the tracking boards are the herd mentality gone digital."

One detractor? A single, semi-anonymous comment can sink a script? I'd heard as much from other writers but had assumed it was just the fruit of febrile imaginations – or sour grapes. But here was the woman who signs the checks, confirming my paranoia.

"If you get behind a project that nobody else wants and it fails, you're fucked. If you buy a project that everyone wants, you're at the front of the herd," she explains. I know she catches the expression that flashes across my face, because she pauses briefly before continuing in a low voice. "This business runs on fear," she says, "and the tracking boards give that fear a voice."

Ben Mezrich (bmezrich@aol.com) *is the author of* Bringing Down the House: The Inside Story of Six MIT Students Who Took Vegas for Millions.

I look around the room – at the stars, writers, directors, producers – and for a moment I can actually see the system at play. A positive track leads to a heated auction, a seven-figure deal, a blockbuster movie – not to mention parties at Sundance. But more likely, the trackers conspire to end your Hollywood career before it gets off the ground.

"If you're dead on the tracking boards," the executive whispers, "you're dead in this business."

Back in LA, I decide to dig a little deeper. Acting on a tip, I find what I'm looking for in a black glass building in Santa Monica. There's no lobby: It's just a stack of spartan offices that rises high into the smoggy sky.

Rafi Gordon, president of Baseline-Film-Tracker, and Alex Amin, executive vice president, are waiting for me when the elevator doors open on the fifth floor. They're young, bright, and shiny in that LA way, affable and smiling. They introduce themselves as they lead me through their office.

Five years ago, there were just a few homegrown tracking boards in Hollywood; today, there are many, but they are all managed by Gordon and Amin. FilmTracker's parent company, Hollywood Media Corporation, specializes in industry-specific databases – film credits, bios, and the like – but the glamour end of the operation is the by-invitation-only boards. They're kept small by necessity. Membership is strictly controlled. Anytime a new studio executive, producer, or development person is hired, one of the first things they do is try to sign on to a board. They're let in either by a democratic vote or an administrator who decides if the applicant is qualified. "We have the tracking-board business pretty much cornered," Amin says.

"I think we're up to 200 separate boards now, tracking over 2,000 projects," Gordon adds, as we reach a corner office. They shut the door behind me. Amin takes a position at a computer on one side of a cluttered desk, Gordon by the window.

"In the beginning," Amin explains, "there was this very rudimentary message board started by a guy named Roy Lee. I was at MGM at the time, about 1997 – hell, we didn't even have email or Internet capability – and Roy started this service that was basically just a bulletin board. People would add comments to a text stream about spec material that was going out for auction."

Spec material – original projects in either script or treatment form – are the lottery tickets of the movie industry. Unlike assigned projects, which are always given to established screenwriters, spec material can come from almost any source: unknowns, wannabes, even novelists like me. Through spec auctions, new projects and writers are introduced to Hollywood. When a studio buys a spec, a career begins.

"Around 1999," Amin continues, "about 12 major-studio junior execs – me included – got together. We wanted something more sophisticated. We wanted to be able to search for the info we needed, to keep archives, to do this quickly. So we built ScriptTracker – which eventually became FilmTracker, a central Web site where tracking boards are managed and maintained."

While he's talking, he's hitting keys on the computer in front of him. I can't see the screen, just the blue-green reflection in his eyes.

"And who uses these boards?" I ask, looking from Amin to his boss.

"Pretty much anyone who has any power," Amin answers. "From the top levels down to the junior execs. Studio VPs, heads of development, producers, buyers, sellers, and assistants. They pay anywhere from $15 to $300 per month for the privilege, depending on their level of access. Currently we have about 10,000 active members."

Robert Dowling, the editor in chief and publisher of *The Hollywood Reporter*, corroborates: "Everybody uses the boards," he says, "and at the highest level they can."

Still, it seems remarkable to me that these two photogenic kids built a machine that's used by everyone from Jerry Bruckheimer's assistant to the head of development at Paramount, from the grunt who reads scripts for Matt Damon to the major buying executives at MGM.

"People begin tracking projects the minute an agent mentions it to anyone else," Amin continues. "By the time a script goes to auction, everyone's already tracked it."

Opinions, comments, information on buying and selling – all of it is available before a project is officially on the market. It's a Hollywood cartel.

"All the information you need on a project is at your fingertips," Amin says smiling. "In fact, I've got your tracking page right here in front of me."

With a flourish, Amin positions the computer screen so I can see. My name flickers past in glowing green type, followed by a description of my Vegas project – and a string of comments from various handles, presumably Hollywood heavies. I quickly read some of the posts:

Crime caper.

Need more info now. Getting buzz.

In at Warner. But they aren't going to …

And then Amin spins the screen away. I feel cold.

Hollywood's way of making sure you know where the power lies is to keep you waiting – which explains why a certain development executive at one of the biggest studios in town is 20 minutes late for our meeting. I'm just cooling my heels in her stark corporate office. Nothing personal.

She finally sweeps into the room and answers the question I've been saving up for her. "Of course you can manipulate the tracking boards," she says, all business

> "If you're dead on the tracking boards," an exec whispers, "you're dead in this business."

except for the playful smile tugging at her lips. "It happens all the time."

I sit up in my chair. If the boards can be gamed, then the auctions that result – and, in turn, the daily liaisons that shape the movie industry – are inherently corrupt.

"Why would people manipulate the boards?" I prod, trying to push her toward the answers I already suspect.

She crosses the office to her desk and drops into her chair. Opening her desk drawer, she pulls out a cordless telephone headset.

"If I wanted to get back at an agent who screwed me on something, I could put on the board that my studio is passing on their script. That would pretty much kill the heat on the project.

"Likewise, maybe as a favor to an agent, I could post something like, 'I love this, my boss loves it.' That will create buzz, and quite possibly people will start bidding preemptively because they're afraid of losing the project."

Movie titles flash before my eyes: *Bubble Boy. Kangaroo Jack. Dude, Where's My Car?*

To prove her point, she logs on to the Film-Tracker board and gestures for me to come over to her side of the desk. "At about 8 this morning, this script called *Pet Store* appeared on my tracking board. It's about to go out, and it's getting some interesting hype."

Leaning over the back of her chair, I scan the trackers' comments. Each begins with a handle, followed by a few words:

This is everywhere.

In at Paramount. My boss is jumping on this!

Better move fast …

And then, simply: *Huh? Talking animals?*

On their own, the comments seem inconsequential. But it's the collective wisdom of 27 top development executives at the major studios: Paramount, Universal, Sony, MGM.

"When someone wants onto the board," She explains, "the moderator emails us all and asks if that person is OK. We can blackball someone we don't like. It's like sorority rush." Is she joking? I can't tell. "I know all these people. So this hype makes me interested. The next step is to call the script's agent, see what's shaking."

She hits the speakerphone. After three rings, a male voice answers. She tells the

agent on the other end that she loves *Pet Store* (no matter that she hasn't actually seen it yet) and she wants to know where it stands. He gives her the standard agent line: It's hot, very hot – we'll have a deal by the afternoon. You better get moving, blah blah, et cetera.

She rolls her eyes at me, then gets off the phone to show me the synopsis. *Pet Store* is about a pet shop. All the animals talk, and there's an evil cockatoo who hacks into the owner's computer, somehow getting the store's bank to foreclose. Now the animals are finding a way to fight back …

She rolls her eyes again. But the tracking is good, the hype is still rising.

"It's really about buzz," she says, deferring to the will of the herd. "Tracking boards create it. This script, as bad as it sounds, has it."

The thing is, as far as I can tell, *no one* has actually read the script yet. It hasn't even gone out to auction; nobody is supposed to *have* this script. I have to ask: "Would a studio buy a project based on positive tracking, without ever reading it?"

She gives me that smile. "They'd never admit it."

I try a different approach.

"Would you turn down a project without reading it because of negative tracking?"

She doesn't even pause.

"Absolutely."

Another day, and another bigwig movie executive won't go on the record. We're sharing a booth at a nightclub, and he's giving me a fat dose of Hollywood reality. "The bottom line? It's the studio's job to say no. A bad track simply gets the job done."

We're in Vegas for yet another movie industry party, and the club is swarming with development people. It all seems a lot less glamorous now. I'm not starstruck

anymore, I'm angry.

"Is it legal? I ask. "Opinions are one thing. But collusive behavior, or manipulative lies – like the pumping and dumping on an Internet stock board – these are more complicated issues. With no regulation, there's just no way to know how dirty the system really is."

My rant is interrupted by a curvaceous blond hostess brandishing a bottle of Cristal.

The producer replies: "Sure, people do try and manipulate the boards. But whether it's unethical or mildly illegal – does it really matter? Good projects turn into good movies. Bad projects turn into bad movies. The buying is just one part of the process."

"It doesn't seem like a very fair system," I say, but I can't sustain my righteousness. I'm embarrassed by how naive I sound. I've seen how the system works, and can no longer pretend that projects are considered purely on their own merits. I am an insider now, reeling from a week that started in Utah, passed through LA, and ended in Sin City.

"No shit," the producer laughs. "I get agents calling all the time: 'Hey, I know you have this project: Please don't kill it.' I don't want any part of it; I actually try to read the damn things."

I nod, but I don't believe him. His words are noble, yet I can see the glint of shark in his eyes.

Someone slides into the booth next to us. It's Dana Brunetti. He's been eavesdropping. He takes a glass of champagne and waves it in my direction.

"You realize, of course, now that you know all our secrets, we're going to have to kill you."

I'm pretty sure he's kidding. ■ ■ ■

"If I wanted to, I could put on the board that my studio is passing. That would kill a project."

TALES FROM THE CRYPT

How a handful of Mormons with an infrared camera unlocked the secrets buried beneath Vesuvius.

by Oliver Morton

Before and after: A fragment of carbonized papyrus recovered from a villa near Pompeii, first seen in visible light, then captured by a multispectral imager originally developed by NASA.

Steve Booras, a computer professional from Provo, Utah, is leading us through a labyrinth that was once a royal palace in the Kingdom of the Two Sicilies. It's hot, and we're hurrying along corridors lined with books. Lots of books. Lots of books in the way Keanu Reeves says "lots of guns." This vast building, no longer home to the royalty of Naples, is now one of Italy's three national libraries. The serried shelves past which we're rushing look tall and long enough to contain all the words written in Italian since the palace was built a few centuries ago.

If we had time – we being two of Booras' colleagues from Brigham Young University, Booras' son, and myself – who knows what we might find in the slightly dusty data arrays that rise high above our heads? Volta's original research on electricity, firsthand reports of Garibaldi's military campaigns, scandalized local accounts of Lord Nelson's dalliance with Lady Hamilton, any number of things that someone, somewhere, once felt moved to write down. But we don't have time. Booras, a neat man in his early sixties who's wearing a smart blazer, is hurrying us along in an almost white-rabbit way, his need for speed exacerbated by the fact that, although he worked in this Borgesian building for more than a year not so long ago, he doesn't seem completely sure where he's going.

Eventually, we come to a pair of rooms, one light, one dark. The light one has high, uncluttered walls painted in an institutional green. The entire ceiling is made of milky glass, smoothing powerful Neapolitan sunshine over everything below. There are stereo microscopes on some of the utilitarian desks. It is a room for seeing.

The dark room next door, on the other hand, is a room for storing. It is ringed by steel cases with wide, shallow drawers that hold trays containing thousands of blackened tatters. In a display near the shuttered windows are some fused cylinders of cinders; they look like turds that have been burned and then fossilized, or possibly vice versa. And that is, indeed, pretty much what happened to them. But they are not turds. They are papyruses, scrolls like those on which all the great thoughts of antiquity were once recorded. The words on them were written down 2,000 years ago; when they were discovered 1,800 years later, they were the first handwritten documents from the ancient world that modern eyes had ever seen.

The reason this stash of papyruses was preserved is just outside the shuttered windows: Mount Vesuvius. On August 24, AD 79, these scrolls were suddenly covered by 65 feet of fast-flowing volcanic mud. In the succeeding centuries, almost every other papyrus in the world was either burned in a more mundane fire or eaten by rats or cut up in order to be recycled into the next technological solution to the problem of information storage – the book. Meanwhile, these scrolls sat preserved beneath the volcanic rock.

But not very well preserved. The volcano's gases carbonized the scrolls almost instantly, and moisture trapped by mud fused the layers of papyrus together. The fragments that fill the steel cases around the dark room represent two centuries of careful if intermittent work unpeeling and pondering about a thousand of these artifacts. On some of the fragments, there are clearly legible words. But many of the others bear almost no sign of meaning, no matter how fervently scholars strain their eyes though the microscopes next door.

Some classicists believe that the papyruses, extracted in the 18th century from the buried town of Herculaneum in the Bay of Naples, are just the blackened tip of an iceberg of knowledge. The unexcavated

Steve Booras and his wife, Susan, at work on fragments of papyrus. Insets from left: the excavation site at Herculaneum; the library in Naples where the texts are now stored; an intact carbonized scroll, still rolled.

Time Machines

Historians are getting their hands on high tech equipment once reserved for the military and corporate research labs. Their goal: to crack the mystery behind pieces of lost history. – Joshua Davis

TECHNOLOGY: Digital modeling
MYSTERY: Michelangelo's Florentine *Pietà*
LEAD INVESTIGATOR: Jack Wasserman

At age 80, Michelangelo broke the limbs off what was to be his crowning achievement: a 7-foot statue of three figures holding a slain Jesus, completed seven years earlier in 1548. Although the sculptor let an assistant repair it, commentators believe he vandalized the work because he hated it. Now technology offers a new perspective. Using a multicamera imaging rig, in the late '90s IBM engineers scanned the *Pietà* and created a 3-D model. Art historian Jack Wasserman then digitally dismantled the repairs. The harmony of the broken sculpture convinced him Michelangelo hadn't wanted to destroy it. Rather, Wasserman maintains, the artist had planned to recarve the arms but was sidetracked by other projects.

TECHNOLOGY: Digital radiography
MYSTERY: Relics from the sunken ship *La Belle*
LEAD INVESTIGATOR: Wayne Smith

In 1684, René-Robert Cavelier de La Salle, the founder of Louisiana, sailed from Haiti toward the Mississippi Delta to claim lands west of the river for France. The expedition was a disaster. Two of four ships sank and eventually the remaining men mutinied. Historians have long wondered if the explorer was deliberately ill-equipped by a skeptical Louis XIV. In 1997, archaeologists discovered one of the sunken ships in the Gulf of Mexico and retrieved a barnacle-encrusted cylinder from it. Researchers x-rayed it and digitally enhanced the contrast, revealing a 17th-century spear – a top-of-the-line polearm, in fact. Royal sabotage was ruled out; La Salle traveled with some of the best equipment money could buy.

TECHNOLOGY: Ground-penetrating radar and thermal cameras
MYSTERY: da Vinci's *The Battle of Anghiari*
LEAD INVESTIGATOR: Maurizio Seracini

During renovation of Florence's Palazzo Vecchio in 1563, Leonardo's fresco *The Battle of Anghiari* was accidentally destroyed. Or was it? Maurizio Seracini has been sounding the palace with low-frequency radar waves since 1976 in the hope of identifying concealed walls. He abandoned his quest during the '80s because the technology wasn't good enough. But with recent advances in portable ground-penetrating radar, he's pinging again, and he's augmenting radar with a thermal camera that can reveal hidden walls as varying shades of gray. If Seracini manages to locate the fresco, it will be the first discovery of a da Vinci in decades.

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parts of the building where these papyruses were found may contain thousands more. It is not entirely fanciful to imagine that they include works of literature and philosophy that have never been seen by modern eyes: lost companions to *The Odyssey* and *The Iliad* from the age of Homer, treatises by Plato and dialogs by Aristotle, tragedies by Sophocles, poetry by Sappho. Those shriveled rolls still locked in the rock could one day form the core of a unique library containing the lost roots of Western European thought.

To get from the library we're standing in to that of the classicists' speculations will be quite a journey. It will require large amounts of money and large amounts of luck, careful negotiation of the politics of Italian antiquarianism and the equally careful removal of thousands of tons of rock. And for that library to be all that it can be – for its works to be readable and relatively accessible – it will also require the expertise of technologists like Steve Booras. Booras can read even less classical Greek than I can read Italian, but over the past few years he has done as much as anyone to make the fragments of ancient knowledge stacked in this darkened room legible. It would be wrong to say that Steve Booras and his colleagues will bring to light a lost classical library of the imagination. But they do have their fingers on the switch.

Until the late '90s, Booras had never heard of the Herculaneum scrolls. Nor had most other laypeople – and rather more surprising, a lot of professional classicists were all but as ignorant. Despite their having been the first papyruses recovered by modern scholars, the Herculaneum scrolls never made it into the mainstream of "papyrology," as studies of smaller stashes found elsewhere have come to be called. Richard Janko, a professor of classics at the University of Michigan, says that this neglect by his profession was extraordinary, but that its cause was clear: "They were just so hard to read."

Janko himself first saw the artifacts in 1986. Intrigued by more than a century of neglected scholarship, he traveled to Naples to see what he could make of the slighted texts. Looking back, he concludes that reading the Herculaneum scrolls was the most difficult challenge he'd ever faced.

Poring over the scraps in the stifling heat of a Neapolitan summer, with every breath of air excluded from the reading room lest it blow away a feather of papyrus, is a formidable endurance test.

Deciphering even one letter under the microscope is an achievement. Janko recalls spending 10 minutes trying to make out the faintest hint of the letters in an almost entirely obscured patch of scroll before realizing he was looking at it upside down. Right side up, it was scarcely more forthcoming.

Studies are often undertaken with partners in order to reduce self-delusion; otherwise, the word you want to see – the word you expect – forces itself onto the Rorschach's cradle of burnt fibers. "You come up with your theory about what letters are there," says Janko, "and then you say, 'The letter after the alpha – what do you see there?' and the person says, 'I see a vertical line then a line going across at the top,' and you say, 'Which letters do you think it could be?' and the person says 'Gamma or tau,' and you say, 'Good, that's what I thought, and I think it's tau, don't you?' and so on."

Not only are the letters somewhere between difficult and impossible to read, but the eye must be constantly aware of the possibility that some are in the wrong place. The process of unrolling the petrified scrolls does not always produce a single layer of papyrus; some patches end up inadvertently detached: What looks like one piece of text may have an island of another layered over it or be pierced by holes that reveal other words beneath. The bumps and potholes may be only a fraction of a millimeter in height or depth, but they can break the axles of a heavily freighted interpretation just like that.

Such challenges, Janko says, have made him see the simple act of reading in a new way. The ideas and their physical representation become entwined, impressed on one another, indistinguishable.

The reason Steve Booras is rushing us through the library is that a ceremony is about to begin, and we don't know where. We retrace our steps and eventually find our way to the director's office, where various dignitaries are gathering. From there, we move on to the ceremony itself. It takes place on one of the lower floors in a richly ornamented, high-ceilinged, gallery-girdled chamber as opulent as the reading room is austere. The event is the rededication of the library's

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Contributing editor Oliver Morton (oliver@wiredmag.com) wrote about tracking strange matter in Wired *11.02. Philodemus poem based on a translation by David Blank of UCLA.*

FROM TOP: COURTESY IBM TJ WATSON RESEARCH CENTER; COURTESY TEXAS A&M; CAMERAPHOTO/ART RESOURCE, NY

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papyrus research center in honor of Marcello Gigante, a local professor who devoted much of his life to the enigmatic scrolls.

The ceremony begins with the presentation of a small plaque to the contingent from BYU. Booras and his colleague Roger MacFarlane, a younger man in a seersucker jacket and a natty bow tie, step up to receive it almost bashfully. On a lectern to one side of the room sits a larger plaque the visitors presented to the library earlier. It displays two different pictures of the same scrap of papyrus. One shows neat lines of Greek lettering. The other is utterly illegible, a ground zero of text. The difference between them is Steve Booras' camera.

Booras and his team have recorded images of every piece of Herculaneum papyrus in the library: 25,000 images on 345 CDs. The images were made with a high-quality digital camera. More important, most of them were also made with infrared filters. On a legible papyrus seen under normal light, the ink appears black because it absorbs the light; the papyrus reflects it. The carbonized fibers of the Herculaneum scrolls, however, absorb light just as well as the ink does, making the background a distinctly low-contrast black. But the papyrus does not absorb infrared wavelengths quite as readily; in the infrared, there is still contrast.

Scholars have used infrared film to tease details out of documents since the '30s. But in the mid-1990s, Gregory Bearman, a researcher at NASA's Jet Propulsion Lab, advanced the practice by converting a digital camera that was able to work in many different wavelengths – a multispectral imager – to the same purpose. It soon started producing results, and Bearman was happy to turn his technology from planets to parchment: "Every space instrument I've ever been closely

found that for most of the fragments a single pass in the 950-nanometer band provided good imagery, though in some cases he used more wavelengths to achieve the best possible definition. A few fragments actually produced their best images in a narrow band of green.

On the day we attend the ceremony in the library, a young researcher bubbling with enthusiasm calls up on his laptop a whole string of favorite images from Booras' collection. The words written on the scrolls, which were read aloud in discussions at Herculaneum before Rome was an Empire, are clear enough to discern distinct styles of handwriting. Two thousand years on, this scholar can recognize the work of individual scribes.

While Janko and his colleagues are finding their labors eased by the new images (for one, they are no longer confined to working in Naples), perhaps the greatest beneficiary of Booras' work is a fairly obscure first-century BC philosopher and poet called Philodemus.

Philodemus does not stand out in histories of philosophy. He was one of a number of like-minded followers of Epicurus who came to the Roman republic after its consul, Sulla, sacked Athens in 86 BC. His greatest claim on the classicists' attention is not so much what he wrote as the fact that much of what he wrote has not yet been read. It is news – news from the deep past.

The literature of Greco-Roman antiquity that exists in books today has been read and read and read again, for thousands of years. It was through this reading and recopying for new readers that it survived. But most classical writings did not survive. Working from the references in extant works, classicists have come to believe that roughly

SUDDENLY TEXT APPEARS. IT IS NEWS – NEWS FROM THE DEEP PAST.

associated with," he says somewhat ruefully, "has been canceled."

In his first application of the technology, Bearman created images of the Genesis Apocryphon, one of the most dilapidated of the Dead Sea Scrolls, and added 20 percent to the known text by revealing letters that were illegible under visible light. This caught the attention of a small team of Mormons working on a CD-ROM version of the scrolls that would include both images and text. One of them was Booras. A software tester at nearby WordPerfect, Booras had for years been using his computer skills to help out with BYU projects. Charitable donations – some of it from Alan Ashton, a former BYU professor and cofounder of WordPerfect – made it possible for Booras to apply digital technologies to ancient texts full-time.

In 1998, using Bearman's advances, Booras presented pictures of burned scrolls from a monastery church in Jordan to an international conference on papyrology in Italy. Marcello Gigante was in the audience and immediately saw that the multispectral technique could be applied to the Herculaneum scrolls. If Booras was in the business of reading unreadable papyruses, Gigante told him, he should come to Naples. They had the biggest supply of them in the world.
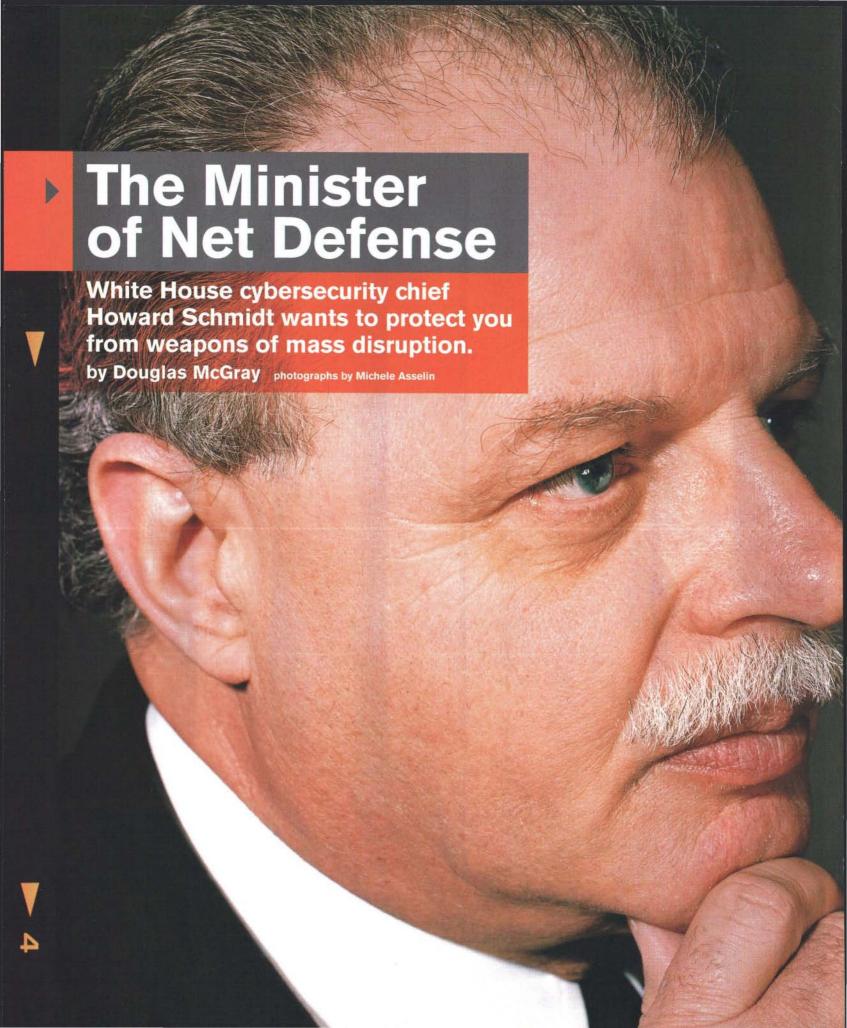
And so Booras spent a couple of years sifting through the almost-ashes in Naples, examining the 4,400 fragments framed in glass. The camera's tunable filter allowed him to sample dozens of narrow bands of visible and invisible spectrum, looking for the band that would produce the clearest text. After checking various wavelengths, he

90 percent of the written culture of Greece and Rome is lost to them. Epic and lyric poetry, towering drama, philosophy fundamental in the shaping of those cultures – all gone.

So, although he's not an Aristotle or a Plato, Philodemus' thoughts fill in a picture of his time. Better still, in expounding his thoughts, he summarizes those of others. He thus provides secondhand testimony on the contents of various lost works by the great philosophers.

That is why years have been spent in the hot, still air of the library. That is why the folds inflicted on the scrolls when Vesuvius crushed the villa above them have been painstakingly measured with calipers so that different fragments from the same scroll can be recognized and reunited. That is why new ways of unwinding the remaining papyruses have been developed and disagreed over. (One being discussed is a gas-based method that allows leaves of paper to float off each other. Used by the IRS to recover information from burned ledgers in tax cases, this technique has also been applied to papers retrieved from the *Titanic*.) That is why the digital images mean so much.

To those who have little interest in Philodemus, let alone his scribes, the pictures might seem interesting yet inconsequential. But Philodemus may be just the prolegomenon. The facts of his life suggest that the scrolls unearthed at the villa in Herculaneum were part of a much larger library. And any large library in those days would have been full of works now lost.

Details of Philodemus' biography are scarce. It's not known

The Minister of Net Defense

White House cybersecurity chief Howard Schmidt wants to protect you from weapons of mass disruption.

by Douglas McGray   photographs by Michele Asselin

WIRED: If there's a big cyberattack, is it likely to be by accident or by design? A hacker's project gone awry or a coordinated terrorist attack?
SCHMIDT: The big one is likely to be very, very focused and very designed. We have this debate internally on a regular basis.

Who is the most likely perpetrator?
Our perspective is, it doesn't make any difference whether it's from a source in the Mideast or from one in the Midwest.

Your predecessor, Richard Clarke, used to talk about the likelihood of a digital Pearl Harbor. Others have dismissed cyberattacks as weapons of mass annoyance. That's a pretty wide spectrum.
I use the term *weapons of mass disruption*. Is it possible that we could have a catastrophic failure on a regional basis? Absolutely. Could we see that on a universal basis? That likelihood has been reduced significantly.

"THE BIG ONE IS LIKELY TO BE VERY, VERY FOCUSED."

What worries you, then?
An unknown vulnerability in a system that someone chooses to exploit in conjunction with some sort of a physical attack.

Wouldn't it be difficult to coordinate a cyberattack with a physical attack like a bombing?
If you have something that can proliferate quickly, like the Slammer, it would be relatively easy to orchestrate.

Most of the big hacks have affected data, rather than control systems. Why is it easier to fry bank records than to knock out the power grid?
The technology that runs the banking system and the Internet is very public. A lot of it has come from a foundation of open standards, so we understand it much better, whereas digital control systems run in a proprietary

Douglas McGray interviewed Andrew Marshall in Wired 11.02.

manner. You need specific knowledge about what it does and how it does it. There has been a shift – appropriately so, for cost efficiencies and everything else – to enabling some of those open technologies in control systems, but we need to protect against those things becoming a failure point.

Walk me through the first moments of a big cyberattack. The Slammer worm, for instance.
The private sector sees what's going on long before the government catches on. Generally, they'll see a spike in activity at some of the main Internet monitoring points. Nanog [North American Network Operators Group] was one of the first groups to post on an email list that they saw something strange.

Would ISPs investigate?
They're the ones monitoring the health of their networks. They figure, jeez, this isn't something where someone has inadvertently turned off the DNS. This is something malicious, and it's moving at an alarming rate.

Then what?
The next step is to identify how the maliciousness is manifesting itself. Is it a worm? Something that somebody sent out via email? Within the first hour or so, there's analysis of the code. Then some of the downstream providers are notified, and the government is brought online.

Who in Washington gets the call?
Right now, it's not as clean as we'd like. In the future, one of the first calls will go to the Department of Homeland Security. [Now] the person on my staff who monitors Nanog gets the call. Simultaneously, the National Communications System is notified and, of course, the FBI's National Infrastructure Protection Center.

Clarke wrote in a memo that the fast-moving Slammer was a dumb worm that was easily and cheaply made. And that, with slight modifications, the results of the worm would have been more significant.
It had no payload. This was strictly a denial-of-service activity in which it was looking for the port and using the worm to propagate a subnetwork connection. The effect of that was some restriction in the use of ATM machines and databases that provide airline reservations. And in one case, a voice-over-IP system for a 911 dispatcher was affected.

What could a loaded Slammer have done?
One payload could have injected other code, which would have opened system backdoors under the context of administrator root privileges. Hundreds of thousands of systems could have been taken over.

Critics have said that your strategy relies too much on the goodwill of big business, that without new regulations, it has no teeth.
What would you legislate? From this moment forward, you will not have more then 10 vulnerabilities during a year? And then what happens? Do we fine you? We have to be very practical when we look at this.

Are there ways besides regulation that the government can enforce its priorities?
The power of the government's purchasing dollar. The Office of Management and Budget now asks, You want to spend money on an IT project? Give me your security plan, or you don't get the money.

How tough will the government really be? Five years from now, if Microsoft still has the vulnerabilities it does today, will you cut it off?
I wouldn't say any particular company ...

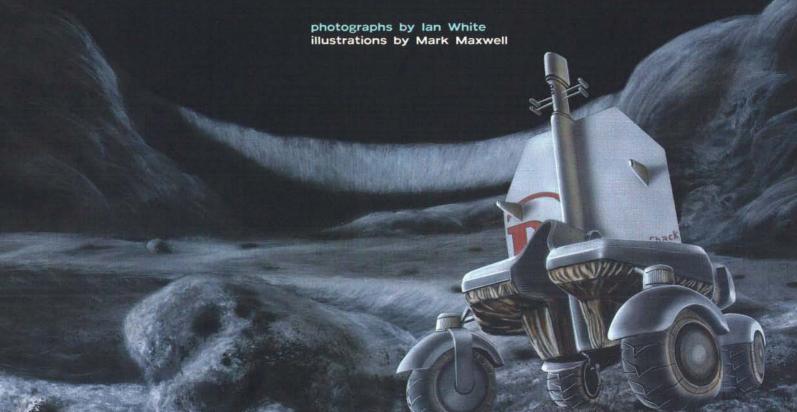**But Microsoft is a good example, because the government is its biggest client.**
If you're not going to provide good security, and you're not going to provide good quality control in engineering in the products you provide us, we're not going to buy it. ■ ■ ■

After 15 years of trying to get a private lunar mission off the ground, LunaCorp cofounder David Gump is slated to take off next year. Eventually, roving "telepresence portals" will beam back the full experience to Earthside theme parks.

THE RACE
BACK TO
THE MOON

Astropreneurs are counting down for a return to Apollo country. The first small step: a satellite atlas of the lunar surface. The next giant leap: ice mining, helium farming, and a launchpad to the solar system.

by Tom McNichol

photographs by Ian White
illustrations by Mark Maxwell

FOR DAVID GUMP, THE JOURNEY OF 239,000 MILES BEGINS FROM A SQUAT OFFICE BUILDING TUCKED BEHIND THE MULTIPLEX 14

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in Fairfax, Virginia. Here, at the headquarters of LunaCorp, the commercial space company he cofounded in 1989, Gump has been keeping a lunatic dream alive through boom and bust: to boldly go where no private venture has gone before – to send the first business model to the moon and return it safely without losing his shirt. "Most space projects have way too many zeros on the end," says Gump, a slender, bespectacled man whose unassuming appearance belies his outsize plans. "You've got to be able to get something that's more in the $20 million range."

Luckily, LunaCorp has a $20 million mission nearly set to go: a lunar orbiter called SuperSat, scheduled to launch in late 2004. And it's not the only one. TransOrbital, a San Diego company, plans to send a private lunar orbiter into space this October. The outfit's Trailblazer satellite will hitch a ride aboard a low-cost Russian rocket, make its way into orbit, and provide high-definition video and photos of the moon's surface. The mission will end with the delivery of a lunar time capsule containing personal messages and memorabilia.

More than 30 years after the last human walked on its surface, the moon has reappeared on the exploration radar screen. In July, the European Space Agency plans to launch the Smart-1 orbiter, the first European lunar probe. Its goal: to flight-test a new solar electric propulsion technology and map the moon using X-ray and infrared detection. In January, Japan will get into the act with its Lunar-A probe, which will send two instrument-laden penetrators plunging into the moon's surface. A follow-up mission in 2005, called Selene, will put two satellites into lunar orbit to study the origin and evolution of the moon. India and China are in an unofficial but unmistakable race to put a man on the moon, perhaps by the end of this decade.

Russia, which sent the first person into space, is offering both rockets and launch facilities to private space firms. TransOrbital has a $20 million contract with Kosmotras, a Ukrainian space firm authorized to use decommissioned Soviet ICBMs. It's a measure of how much the world has changed since the days of Apollo that a private American space company is relying on an SS-18 missile once pointed at America.

NASA doesn't have a moon mission planned, but that may change. The 2002 National Research Council Solar System Exploration Decadal Study, which will set NASA's exploration agenda for the next 10 years, says "the moon provides a baseline for much of planetary science." It gave a high priority to sending a return mission to the Aitken Basin, at the moon's south pole. "We're coming out of the wilderness years of lunar exploration," says David Lawrence, a scientist at Los Alamos National Laboratory's Space and Atmospheric Sciences Group.
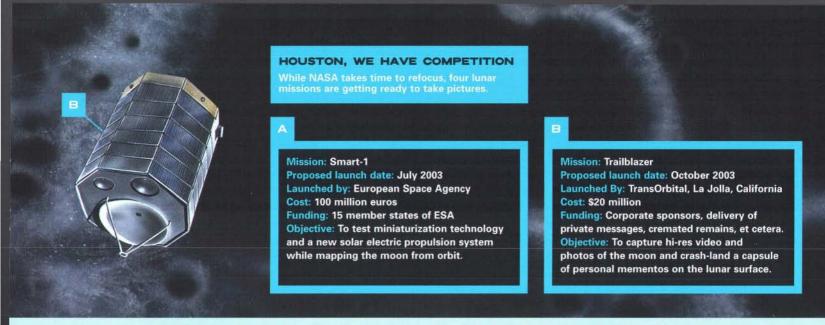
The lunar ventures all intend to make some detailed photographs that will help develop precise maps of the moon and, by extension, get the public excited about it again. Like TransOrbital's Trailblazer, LunaCorp's SuperSat is basically a flying video camera, a broadband probe that will beam back digital video of the lunar surface over a 25-Mbps communications channel. To get the payload into space, Gump is considering a variety of launch options, including the European Space Agency's Ariane 5 rocket. With the communications satellite market in a recession, the cost of sending a small payload aboard Ariane 5 has dipped below $10 million.

Another plan would have the space shuttle deliver SuperSat, unassembled, to the International Space Station, where a payload specialist would put it together – a proposal NASA had shown interest in before the loss of *Columbia*. The shuttle's near future may seem muddy, but Gump believes NASA will come around. "We know now that the shuttle's failure rate is 1 in 55, which is higher than anyone thought," he says. "But the failure rate of an expendable rocket is about 1 in 20, so the shuttle is still less risky." Once SuperSat gets off the ground, the plan is to have it lock into a lunar orbit and map the surface with an HDTV camera and panospheric video. The images will be beamed to science centers, where visitors will be able to turn the camera in any direction to see the view from the spacecraft.

With so much of space left to explore, why bother going back to the moon? For one, to answer a crucial question: Is there water? The 1998 to '99 flight of NASA's Lunar Prospector detected large concentrations of hydrogen at the moon's poles, a strong clue that there may be considerable deposits of ice. If so, the discovery would revolutionize the economics of lunar exploration overnight. Because water can be broken down into hydrogen and oxygen, it provides both fuel and breathable air; a local supply would save the high cost (up to $20,000 per kilogram) of shipping water on a spacecraft. Suddenly, the moon would change from a barren place to plant flags and leave footprints into a potential space colony – and a jumping-off point for exploration of Mars and beyond.

Contributing editor Tom McNichol (mcnichol@wiredmag.com) wrote about biorobotics guru Robert Full in Wired *10.11.*

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Mission: **Smart-1**
Proposed launch date: **July 2003**
Launched by: **European Space Agency**
Cost: **100 million euros**
Funding: **15 member states of ESA**
Objective: **To test miniaturization technology and a new solar electric propulsion system while mapping the moon from orbit.**

B

Mission: **Trailblazer**
Proposed launch date: **October 2003**
Launched By: **TransOrbital, La Jolla, California**
Cost: **$20 million**
Funding: **Corporate sponsors, delivery of private messages, cremated remains, et cetera.**
Objective: **To capture hi-res video and photos of the moon and crash-land a capsule of personal mementos on the lunar surface.**

The initial moon race was about getting there first. The second race is about turning the moon into a piece of real estate that will sustain future missions – and this time, private enterprise has a place at the starting blocks. "We spent $26 billion to get to the moon, and what did we gain besides beating the Russians?" says Alan Binder, founder and director of the Lunar Research Institute in Tucson. "Teflon and Tang don't cut it. Once you have humans on the moon that are not government-approved astronauts, then the whole thing will take off."

IN THE EARLY '80s, David Gump edited a pair of aerospace newsletters, *Space Business News* and *Military Space*. After publishing dozens of stories about the impending commercialization of the space shuttle, he started to believe his own hype. He wrote a manifesto for private exploration, *Space Enterprise: Beyond NASA*, and formed LunaCorp with a group of fellow enthusiasts. But over the next decade, the commercial space market never left the launchpad. No one was willing to pour millions into such a highly speculative area, and NASA remained a reluctant, slow-moving business partner.

To survive, LunaCorp took on space marketing projects, acting as a broker between NASA, the Russian Space Agency, and private enterprise. In May 2001, it arranged the first TV ad shot aboard the International Space Station: a Father's Day spot for RadioShack. It also coordinated having an astronaut aboard the ISS throw the ceremonial first pitch of the 2002 World Series, and even had a hand in Lance Bass' celebrated effort to get into space. LunaCorp shuffled some RadioShack dough to pay for Bass' medical screening, but the 'N Sync star wasn't able to raise the $20 million needed to get into space.

Meanwhile, LunaCorp was testing out its satellite communications skills with the Robotics Institute at Carnegie Mellon University. As part of the Lunar Rover Initiative to confirm the presence of ice at the moon's poles, the institute conducted field trials of robot prototypes in the Arctic and in Chile's Atacama Desert. Gump and company provided the satellite stream for the latter mission. "A research program like ours simply can't pay for a live videostream from the Chilean desert," says William Whittaker, director of the Robotics Institute's Field Robotics Center. "But LunaCorp is able to do it through connections in the space industry and by calling in favors."

Through it all, Gump has paid a substantial price to keep his company going. He took out a second mortgage on his house, and then a third, sending his credit rating into a death spiral. The Apollo program's primary challenge was technology. Today, getting a high-thrust rocket motor to perform a successful translunar injection burn is easy compared with raising funds. To convince companies like Nike and Pepsi to part with a few million dollars, LunaCorp is packaging the first commercial lunar mission as an *event*. RadioShack has kicked in several million dollars, and Gump is betting that other large companies will follow suit. He's also working on TV deals, Web site fees, and sales to science centers. "David's very persistent," says Buzz Aldrin, the second man on the moon and a LunaCorp consultant. "He's been at this a long time, but that's what you have to do. You can never tell when a commercial space venture will suddenly become viable."

THE ROAD to viability for any aspiring commercial launch winds through a bureaucratic maze. The US government doesn't issue moon permits as such, but a private lunar probe has to go through a lengthy regulatory process. Soon after TransOrbital announced plans for a lunar orbiter dubbed 2001 Trailblazer, it found the mission smothered in red tape. "People told me it would be no big deal, that you could get approval in about 30 days," says Dennis Laurie, president of TransOrbital. "It wound up taking two years."

On its 90-day trek, Trailblazer plans to beam back dramatic hi-res shots of earthrise. (While *Apollo 8* captured the most famous image of the big blue marble in 1968, TransOrbital expects a much sharper picture from its cameras.) This meant securing FCC approval for Trailblazer's use of radio frequency bandwidths. And the cameras required a remote sensing permit from the National Oceanographic and Atmospheric Administration. Furthermore, Earth images taken from space are governed by an international treaty requiring any commercial entity to make its photographs available to any government whose land appears in the image.

And that wasn't all. NOAA had to ensure TransOrbital complied with the Outer Space Treaty of 1967, which holds countries liable for contamination of the lunar environment resulting from commercial activities. TransOrbital had to show that its mission wouldn't leave any hazardous debris on the moon or in orbit, and that it wouldn't disturb the Apollo and Russian Lunakhod landing sites. Also, TransOrbital had to agree to provide the US government access to any data deemed necessary for national security or foreign policy purposes. Before NOAA gave its final approval, it consulted with the State Department and the Department of Defense

TransOrbital president Dennis Laurie aims to have his Trailblazer within 50 kilometers of the surface and snapping high-resolution pictures come October. "We may pick up the outlines of a flag."

FOOTPRINTS ON THE MOON

to evaluate the mission's possible impact on national security.

Since Trailblazer will launch from Kazakhstan, every component falls under the International Traffic in Armaments Regulations, a set of byzantine rules designed to prevent US military technology from falling into foreign hands. Nearly all spacecraft technologies are considered to have a possible military use, and TransOrbital had to show that it was meticulously following security procedures. (LunaCorp has avoided enlisting the help of the Russians, in part because of the strict regulations of technology transfer. But any private American firm radioing home images from space needs NOAA and FCC sign-off.)

The laborious process was finally completed in August, when the State Department issued a letter granting approval. "If you wanted to transfer a nuclear weapon to the Russians instead of a satellite, you'd essentially have to go through the same procedure," says Laurie. "We're the first company to get this licensing for a commercial mission to the moon, and we intend to take advantage of that."

Trailblazer is slotted for an October-December launch window, set to take off from the Baikonur Cosmodrome aboard a Russian Dnepr rocket. The Dnepr is a converted SS-18 ICBM codenamed Satan
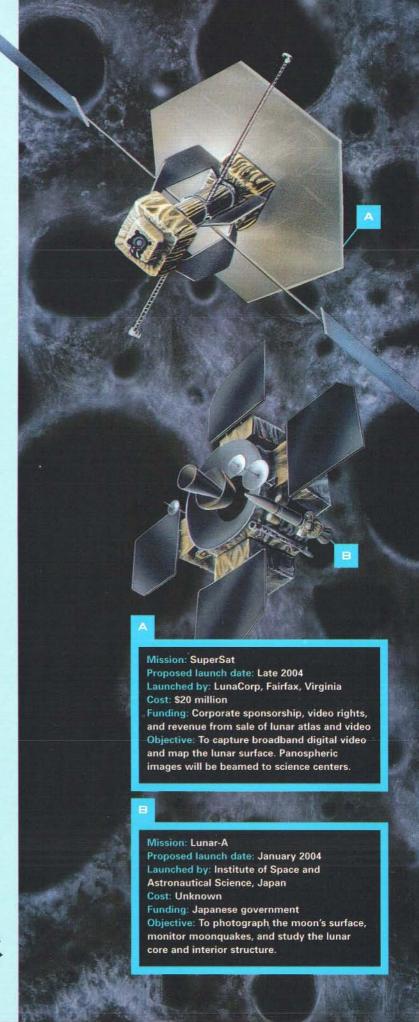
"NASA THINKS IT OWNS SPACE," SAYS THE DIRECTOR OF THE LUNAR RESEARCH INSTITUTE. "ANYONE ELSE ISN'T WELCOME."
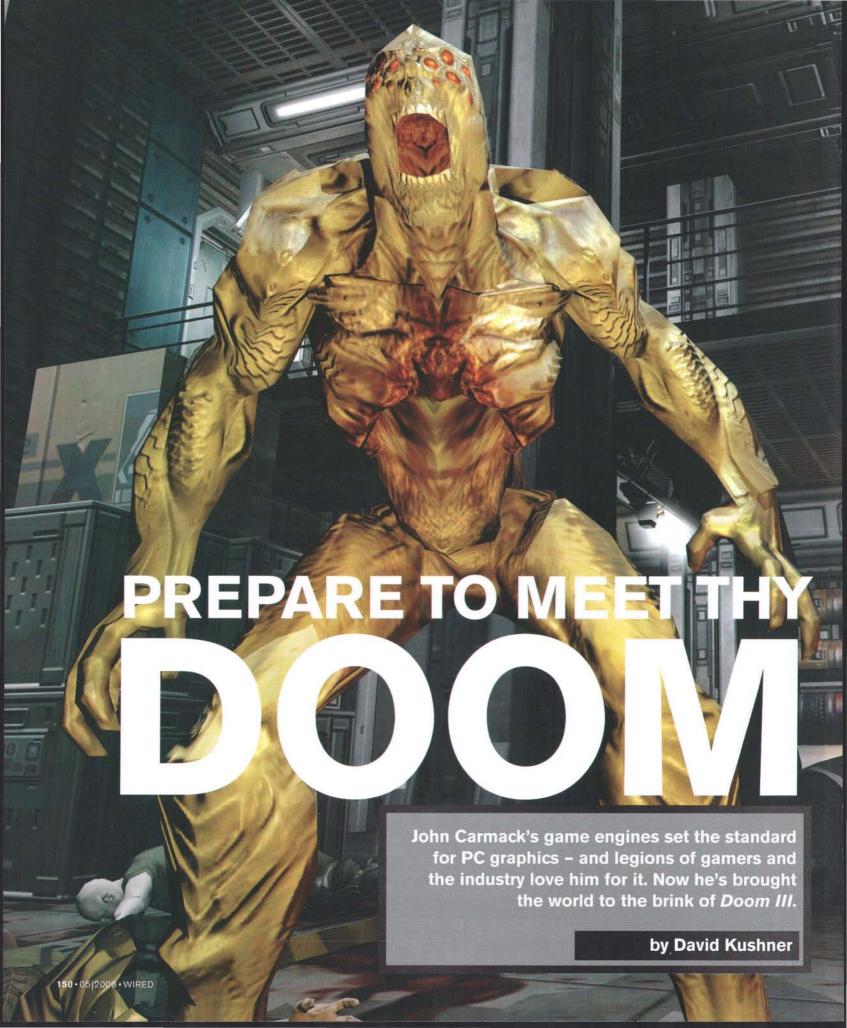
by NATO commanders during the Cold War. Under the Start treaty, the Russians are required to destroy several hundred old ICBMs. By removing the warhead and using the rocket as a launch vehicle, the Russians satisfy the treaty and make a bundle.
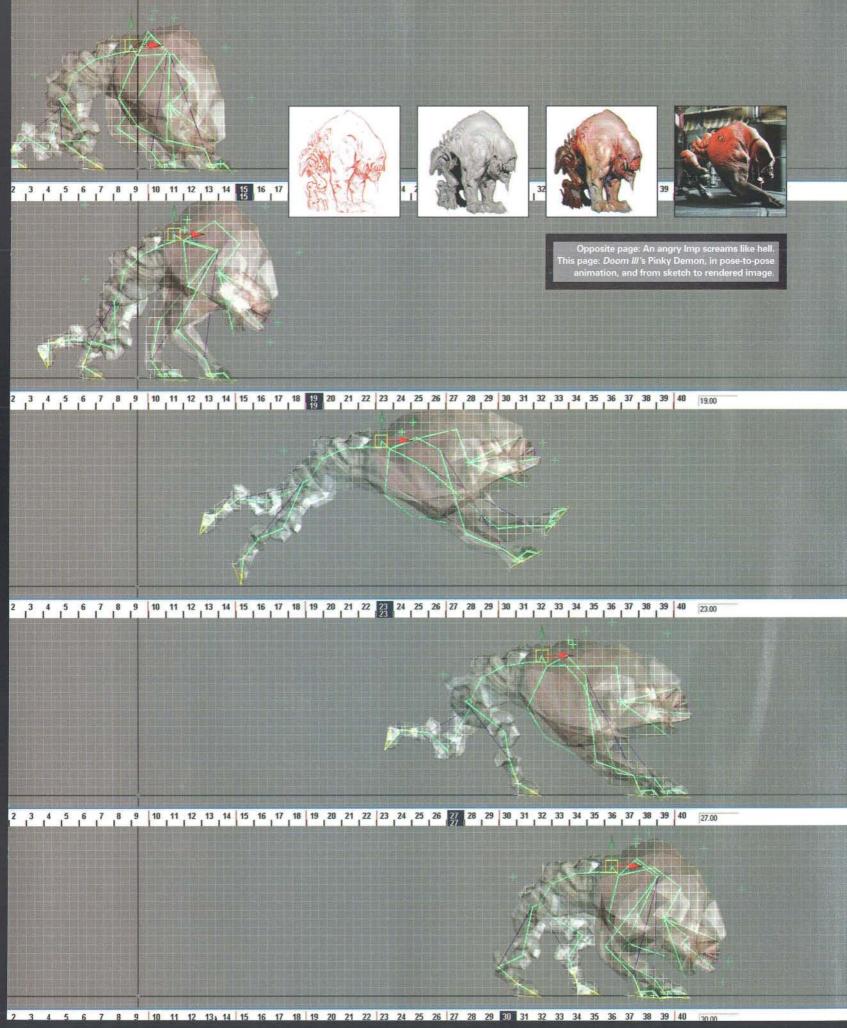
Trailblazer is scheduled to reach the moon in four days, taking pictures of the receding Earth and approaching lunar surface along the way. Once the probe nears the moon, it will go into an elliptical, 18-hour polar orbit for 60 to 90 days, flying as close as 50 kilometers above the surface and recording hi-def still and motion images with 1-meter resolution. "We should be able to see some hardware from past Apollo and Russian landings," Laurie says. "We may pick up the outlines of a flag." The spacecraft will also take stereographic images of the surface, combining two shots from different perspectives, and a lunar atlas for sale to the public will be produced as a result.

The mission will end with a bang. The probe will speed toward the surface, taking barnstorming video until it slams into the lunar dust. The probe will be destroyed on impact, except for its titanium time capsule. People can, for $16.95 to $59.95, write a message that will be carried on an archive disc. Sending an actual item will cost $2,500 per gram. Laurie says he's already taken reservations for business cards, lockets, rings, artwork, and even cremated remains. "People are telling us they want to look up at the moon and say, 'There's Grandma,'" he explains.

Laurie is counting on revenue from sales of the lunar atlas and of the high-definition images and video for use in feature films, advertising, videogames, and educational materials. He says the company is "pretty much on schedule" to raise the necessary funds. "I have a lot of respect for what David Gump's done," says Laurie. "But I want him to finish second in this race. We intend to be the first commercial venture to the moon. That can be done only once."

A

Mission: SuperSat
Proposed launch date: Late 2004
Launched by: LunaCorp, Fairfax, Virginia
Cost: $20 million
Funding: Corporate sponsorship, video rights, and revenue from sale of lunar atlas and video
Objective: To capture broadband digital video and map the lunar surface. Panospheric images will be beamed to science centers.

B

Mission: Lunar-A
Proposed launch date: January 2004
Launched by: Institute of Space and Astronautical Science, Japan
Cost: Unknown
Funding: Japanese government
Objective: To photograph the moon's surface, monitor moonquakes, and study the lunar core and interior structure.

PREPARE TO MEET THY
DOOM

John Carmack's game engines set the standard for PC graphics – and legions of gamers and the industry love him for it. Now he's brought the world to the brink of *Doom III*.

by David Kushner

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"HOW ARE THE FINGERS?" coder Jim Dosé asks artist Kenneth Scott, as they stand in the kitchen of id Software's Mesquite, Texas, headquarters. "Shattered," Scott replies wearily, waving a splint – the result of a rare office football game played to ease tension. But he'll type with the eight digits that work. Lead designer Tim Willits hobbles in with a thigh of busted capillaries from the same game. The art guys just scanned his wound to use as skin for a monster.

These days, the employees at id need to play with pain. They're hard at work on *Doom III*, which is already a shoo-in for event of the year in the $10.8 billion videogame industry, even though it's not expected out until fall. In the dozens of times I've come here to research *Masters of Doom*, my book about John Carmack and his ex-partner, John Romero, I've never seen id's office as focused as it is now. There are no CDs whizzing into walls like Frisbees. No keyboards being hammered during *Quake III* marathons. No screams of the traditional shooter deathmatch taunt, "Suck it down!" Right now, the only things being sucked down are the brownies and coffee in the kitchen – a caffeine-sugar slammer to fortify the troops for yet another late night.

A $108 million brand (counting the first two titles and various expansion packs), *Doom* napalmed the path for everything that followed: the first-person shooter action of *Halo*, the Internet play of *EverQuest*, the ultraviolence of *Grand Theft Auto III*. *Doom* was the first product to invite gamers to get under the hood and fiddle around with accessible, adaptable code that allowed for modifications, or mods, and there are versions based on everything from *Star Wars* to *Aliens*. As *Doom* and its successors became gaming standards, companies like Valve and Raven licensed id's graphics engines to create their own shooters.

Like the original, *Doom III* casts the player as a lone space marine in a Martian military base where a group of scientists have unwittingly opened a portal to hell. But it's hardly a rehash. The new game sets a benchmark for computer graphics, just as so many of Carmack's innovations have done in the decade since id released the first *Doom*. By ushering in the age of 3-D acceleration with *Quake* in 1996, Carmack all but invented the graphics card industry currently dominated by Nvidia. Today, at a time when few applications stretch the capabilities of a $500 PC, Carmack creates programs that require high-end systems. "Carmack's games always push the envelope," says David Kirk, chief scientist at Nvidia. "*Doom III* is the harbinger of technology to come."

These days, the game is also the harbinger of all-nighters. During slow times, Carmack, who builds high-powered rockets with pet project Armadillo Aerospace in his spare time, leaves at 2 am (he usually arrives around noon). The hard work is paying off. A mere *demo* was Best of Show at last year's Electronic Entertainment Expo. Rumors abound that this could be Carmack's last major work. *Doom III*, says Matt Helgeson, senior editor of *Game Informer*, "has slightly lower expectations around it than the second coming of Jesus."

The brownies vanish. The coffee drains. The pressure resumes. As level designer Christian Antkow says, "We cannot fuck this up."

FROM THE DAY his mother took him for a TRS-80 programming course when he was in the fifth grade, John Carmack dedicated himself to creating compelling computer graphics. After being thrown into a juvenile home for stealing an Apple II at age 14, he took the opportunity to create *Wraith*, a sprawling role-playing game that emulated the ambitious *Ultima* franchise. In 1990, while working at Softdisk, the Shreveport, Louisiana-based software company where he met his future id partners, the 19-year-old Carmack figured out how to bring side-scrolling to the PC so he could re-create the arcade action of *Super Mario Brothers 3*. He used the same breakthrough on id's first best-seller, *Commander Keen*.

Since then, Carmack has written a new graphics engine for almost every product he's developed. In an essentially visual medium, the graphics engine – the core code that determines how images are displayed on the screen – is the brain of any game. And with each new engine, Carmack's achieved a higher level of immersion and realism. He's a hero among coders for particularly elegant programming that pushes the limits of hardware.

In 1991, coding a game called *Hovertank*, Carmack faced a challenge no programmer had yet tackled: how to get a computer to quickly render a three-dimensional world from a first-person perspective. Previous games wasted processor power by having the

David Kushner (david@davidkushner.com) *is the author of* Masters of Doom: How Two Guys Created an Empire and Transformed Pop Culture, *due in May from Random House.*

computer draw all the walls within range of a character, whether they're in his field of vision or not; Carmack's breakthrough was to instruct the machine to draw only what the player would see from his point of view. It was the original first-person shooter. Two years later, *Doom* introduced variable floor and ceiling heights and walls without 90-degree angles. It was another step toward graphical immersion, giving players the feeling they had been dropped into the game.

With *Quake*, released in 1996, Carmack went to the next level. Another first-person shooter, it pioneered three-dimensional polygonal characters as well as a more fluid 3-D world that let players see in any direction. "I would spend time just looking down at a corner inside the game," Carmack recalls, "just walking around, feeling the world is solid, it's really there." *Quake III Arena* added further refinements, including curved surfaces and colored lighting.

For years, games have been racing to catch up to the visual standards of animated films. Before long, Carmack says, game graphics will rival *Monsters, Inc.* in their detail. When that happens, technical advances in games will proceed at Hollywood's more measured pace – incrementally instead of in great, creative leaps. Innovators will focus on optimizing existing code, and major revisions will happen less frequently. In effect, Carmack will be obsolete. "There's a real chance that the next-generation rendering engine will be a stable, mature technology that lasts in more or less its basic form for a long time," he says. "Programmers will move from being engine coders to being technical directors in the Pixar style."

Eventually, Carmack says, real-time rendering will be so dynamic that animators will be able to produce films using game engines. Motivated modmakers will have the tools – for free, if Carmack has his way – to bring to life a vision as compelling as the new film *Finding Nemo* (see "Swimming With Sharks," page 62). In his book *Pattern Recognition*, William Gibson writes about a "Garage Kubrick." Carmack foresees a Basement Disney.

The ideal Carmack has always had in mind is the Holodeck, the immersive simulation device on *Star Trek: The Next Generation*. It's science fiction, of course, but a major influence on his thinking all the same. "When I create a game, I'm not telling a story," he says.

"I'm creating an environment in which interesting things will happen." If, as Carmack believes, graphics engines are reaching a plateau, "now is the time to do a generalized environment" that would be the ultimate mod – a programmable virtual reality like the Metaverse described by Neal Stephenson in *Snow Crash*.

Carmack presented the idea to id in early 2000, not long after he finished *Quake III Arena*, but all he got was blank stares. His colleagues wanted to make *Doom III*, a sure-fire hit, not some futuristic environment the market might not embrace. He admits to some disappointment, but he's not done with the idea. "It's a moral imperative that we create this," he says.

In the meantime, there's business to attend to. The graphics advances Carmack is pioneering with *Doom III* are already attracting attention from the software developers who license id's code. Carmack's engines are the gold standard of the industry; the engine for *Quake III* fetches a $250,000 flat fee plus a royalty from the licenser. License deals now account for 20 percent of id's revenue, according to CEO Todd Hollenshead. That means game sales still bring in most of the money – but competition there is growing. In the past three years, shooters like *Halo* and *Unreal Tournament* have eaten into *Quake III Arena*'s market share. But id could pocket some cash from Microsoft. Redmond keeps calling, trying to convince the company to release a version of *Doom III* for the Xbox: "We're being offered a pretty significant amount of money to sit on it until an Xbox port is done," says Carmack. id hasn't announced a decision yet.

LATE ONE NIGHT in September 2000, Carmack saw the light – everywhere. He was months into the development of *Doom III*, and as he sat in his office, he watched neon splash the Mexican restaurant across the street. Starbursts refracted on the hood of his Ferrari in the parking lot. A beam from a streetlamp shot through the slits in his blinds and onto the lizard statue resting on a shelf of thick technical books.

Carmack had long perceived the world through an Impressionist lens, with light being key to perception. Now he was beginning to see realistic, dynamic lighting as the last remaining roadblock between the current state of game graphics and the Pixar-quality engine he envisions.

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We
women's entertainment

Dressed in jeans and a white Advanced Micro Devices T-shirt, Carmack sat at his desk and pecked at his PC. Onscreen, a bloodred cube hovered below a matrix of white lamps. As the cube spun, it cast a variety of shadows on the steel-colored walls surrounding it. The interplay looked compelling, Carmack thought, reaching for his soda, but he still had to figure out how to unify the light-surface interactions. More urgently, he needed another diet Coke.

When he rose from his desk, his photosensitivity lingered like a hangover. He was so immersed in his task that he saw the world around him as an optical display. In the shower the next morning, three perfect bars of light reflected on the tiles. Hey, Carmack thought – that's a diffuse illumination by a specular reflection.

For centuries, artists have tried to capture the effects of light to present an image just as the eye sees it; Monet meticulously painted every spot of sunlight on the London's Parliament building at different times of the day. Today's game developers struggle with the same thing. "It's about creating a suspension of disbelief, and the thing that lets you do that is lighting," says Andy Thompson, director of advanced technology marketing for ATI Technologies, the Ontario-based company that manufactures Radeon graphics cards. "Lighting is critical to making people think a game is real."

Real enough to be frightening, anyway. Ever since the Nazis in *Wolfenstein 3-D* screamed at the player, id has aimed to horrify. *Doom III* is the creepiest yet. "We want to scare people," lead designer Willits says. "You do that by surprising people. And you do that by grossing them out."

To induce that level of fear, Carmack knew he had to eliminate what he refers to as "the Hanna-Barbera effect." In *Road Runner* cartoons, he says, you can always tell which boulder is going to fall, because it's a slightly different hue than the static background. The light doesn't look right. Until now, lighting effects in games were dictated by graphics cards in a limiting way. Games couldn't render general-purpose dynamic shadows, Carmack says, so they used light maps, static dark patches essentially painted on a surface.

Inside id's art room, a dark chamber littered with H. R. Giger alien statues and books about Japanese art, animator Fred Nilsson boots up a rudimentary level of *Doom III* called Delta Map 2. The goal here, Willits explains, is to find an imprisoned scientist who can help point the way to the gates of hell. In classic id style, the halls leading through the base are haunted-mansion spooky: narrow, winding, and flickering with light. More harrowing, players can inadvertently shoot out the lights, which lures nocturnal mutants onto their path. It's certainly scary stuff. As we creep past a room where a zombie is munching on the brains of a dead scientist, an Imp flies up through the grates below, shooting fireballs.

When he makes the engine for a new game, Carmack has to predict the capabilities of PC hardware two years down the road. "There's no real hard and fast rule," he says, "but roughly we buy the very best stuff we can get at the start of development and target that as what we're shooting at."

For *Doom III*, that meant predicting in 2001 what hardware would be available today. Given the then new generation of programmable graphics cards represented by Nvidia's GeForce, Carmack figured he could leave static light maps behind. These new cards were powerful enough that coders could script their own real-time lighting algorithms to render, for instance, a moving ceiling fan casting an intermittent shadow on a demon's hide, or a fluorescent light reflecting off the teeth of a chain saw.

By betting on a certain kind of hardware, Carmack creates industry standards. At stake are millions of dollars in upgrades, not only in graphics cards but in the surround-sound systems gamers will need to hear an Imp creeping up around the corner. According to postings on the Web, ATI was so eager to capitalize on Carmack's latest engine that the company leaked a *Doom III* demo on the Net last November. Gamers hypothesized that ATI did it to showcase its high-end Radeon 9700 Pro series before *Doom III* hits the shelves. ATI's Thompson denies knowledge of a leak. But he admits the game is already reshaping the $1.6 billion graphics card business. "*Doom III* shows off the performance of the hardware," Thompson says, "and that justifies us showing off more new chips next year."

Even with all that processing power at his disposal, Carmack then squeezes out every ounce of performance he can. For the game's monsters, he created an algorithm to reduce a 500,000-polygon character to a mere 2,000 when viewed at a distance – just the amount to ensure the game's speed. Carmack also fixed the tendency for shadows to invert when the viewer's eye was inside the darkness by calculating the shadows from above instead of from the player's point of view. The technique inspired several dissertations and a name: Carmack's reverse.

"It was one of those really elegant solutions," says Carmack, that could come only after grueling hours of work. "There's this cultural stereotype of a person staring off into space until a light bulb turns on, but that's just intellectual laziness. You have to get inside a problem and work it."

"Next victim!" shouts Todd Hollenshead. Just outside the Mesquite Rodeo, pasty guys in black T-shirts line up next to a small stage, waiting to go under the knife. Wielding clippers that move in flashes of silver, Hollenshead and Marty Stratton, id's other "biz guy," cut *Quake*'s clawlike logo into fanboy skulls.

The occasion is the seventh annual Quake-Con, a gathering where Carmack will unveil a more advanced demo of *Doom III* for the public. More than 3,000 armchair space marines have made the trip, schlepping along their elaborately configured PCs to compete in a marathon 72-hour deathmatch. The entire convention hall is snarled with cables networking the gamers, who chug free samples of high-caffeine Bawls soda as they play.

Carmack peels into the parking lot in his cherry-red Ferrari and beelines for the rear door. "I never wanted to be a celebrity," he says backstage. But he braves the crowd to deliver "one of my normal long technical rambles." What the crowd really wants to know is what Carmack will do next. Will he ever make another engine now that he's spending so much time over at Armadillo Aerospace? "That's always the way it is with John," according to id co-owner Adrian Carmack (no relation). "At any point he might leave."

For now, Carmack plans to remain close to earth – and id. *Doom III* will spawn spinoffs: a mission pack with more single-player features, a multiplayer expansion add-on, possibly a program to dynamically render unique new levels on the fly. Eventually, he'll begin work on his next graphics engine. *Doom III* won't be his last, he says, but the days of hammering out a new engine every few years are coming to an end. Soon, he says, "hardcore programmers won't have a good reason to write engines all the time. They'll do it because it's kind of fun." ■ ■ ■

←149 **WHEN THE** three-man crew of *Apollo 17* returned to Earth in December 1972, the Apollo program officially came to a close. After more than a decade of obsession, NASA abandoned the moon.

But space scientists continued to see the importance of understanding Earth's closest neighbor and pressed for further missions. The Lunar Research Institute's Alan Binder has come as close as anyone to launching a successful commercial lunar probe. He was a key player in some of NASA's choice ventures – including his role as a principal investigator on the 1976 Viking Mars lander, which made the first unmanned touchdowns on the red planet. But he grew to believe that the agency's big-budget "flag and footprints" projects were a dead end. In 1989, he founded a nonprofit company, Lunar Exploration, to define, promote, and raise money for a commercial lunar probe. Binder didn't get NASA involved at first, feeling that talk was about the only cheap thing at the space agency. "The biggest obstacle to commercialization is NASA itself," he says. "I said, 'Look, I'll find

Prospector was unable to confirm the existence of water, despite a heroic last effort. Originally, the mission was supposed to end with the spacecraft careening into the moon when it ran out of fuel. After the hydrogen findings, operators decided to use the crash more creatively. Prospector was sent into a 1,100-mph suicide plunge. Scientists made a spectral analysis of the impact plume but found no evidence of water. "We won't know if there's water on the moon until we go digging," says Binder. "But I'd be willing to bet there is."

A water discovery may be what it takes to re-ignite NASA's interest. Officials say that due to funding shortfalls for the International Space Station, no manned lunar mission is planned for the foreseeable future. Privately, some NASA scientists say the moon gets shortchanged because of politics within the agency. "Most of the missions that get funded have the involvement of the Jet Propulsion Lab," says one NASA insider. "And JPL is not interested in the moon at all. They prefer missions that feature remote sensing technology that they've already developed." The best hope is that NASA's Discovery program

according to David Criswell, a physicist at the University of Houston and director of the Institute for Space Systems Operations, is to harvest solar power from the moon. He proposes a system consisting of 20 to 40 lunar bases containing a series of solar cells. The power would be sent over buried electric wires to microwave generators that would convert the solar electricity to microwaves, which would be beamed back to Earth.

Criswell estimates that harnessing just 1 percent of the moon's solar energy could replace fossil fuel power plants on Earth. "The first thing you'd want to have is a government-sponsored demonstration that the system works," he says. "It's a bit like the interstate highway system. Once the government funded it, all sorts of businesses opened up along side it. But you couldn't expect the businesses to build the highways themselves."

IF SIGNIFICANT progress is made in tapping some of those natural resources, the public could become captivated by the moon all over again. LunaCorp is counting on it. At company headquarters, Gump has developed prototypes of what he calls telepresence por-

THE PRIZE: ENOUGH ENERGY TO SATISFY EARTH'S NEEDS FOR THOUSANDS OF YEARS.

the investors, there won't be any risk to your budget,' and they still didn't care. Basically, NASA thinks it owns space. And anyone playing in its backyard isn't welcome."

NASA did finally partner with Binder – by adopting his independent mission. In 1995, NASA chose Binder's probe, the Lunar Prospector, to be the third round in the agency's Discovery program of "better, faster, cheaper" lunar and planetary missions – a $63 million endeavor. Lunar Prospector was launched in January 1998 and went on to conduct a 19-month orbital mapping mission. At one point, the spacecraft's path lowered to within 6 miles of the surface, allowing the probe to obtain data at much higher resolutions. Then a startling finding came from the neutron spectrometer, which indicated significant amounts of hydrogen at the poles. If that hydrogen were locked up in ice, it would mean the moon has water – lots of it. The deposits suggest there could be 200 million tons of ice crystals less than 2 feet beneath the surface.

will adopt a lunar South Pole project.

The way to sell lunar exploration to NASA and private enterprise alike is to show that the moon can deliver a tangible payoff. The presence of water would establish the moon as a safe harbor for further exploration and a test bed for new technologies. It would also likely spur a wave of investment from the likes of Lockheed and Boeing. "The reason to go back isn't science," says Los Alamos' Lawrence. "It's to learn how to make use of non-Earth resources. Science can go along for the ride."

Whether or not it has water, the moon definitely contains other natural resources that could prove beneficial to earthlings. Among them: helium 3, a nonpolluting fusion fuel source. Only several hundred pounds of the isotope of common helium, discovered in 1939, are thought to exist on Earth. Scientists estimate there are about 1 million tons of helium 3 on the moon – enough to satisfy Earth's energy needs for thousands of years.

Another way to supply Earth with energy,

tals, designed to immerse users in the sights, sounds, and motions experienced by a lunar rover. A small rubber-tired rover with a video camera strapped to its back rumbles across the mock lunar landscape constructed on the ground floor of its office building. Mission Control it's not. But it's good practice.

One day – when the $130 million cost of actually getting a rover to the moon comes down – LunaCorp will beam this immersive experience to ticket-holding visitors at science centers, planetariums, and theme parks. Users will sit in a hydraulic chair that rocks, rolls, and dips in tandem with a rover steered by joystick over the rocky lunar surface.

There's no shortage of ideas about how to generate revenue streams once a rudimentary lunar infrastructure has been established. Helium 3 mining operations. Solar energy farms. Orbiting lunar hotels. The problem for companies like LunaCorp and TransOrbital is staying alive until those ideas become more than just lunatic dreams. The second race to the moon awaits its *Sputnik*. ■ ■ ■

when he was born or died, how long he spent in Alexandria (possibly) or Athens (definitely). It's not known which, if any, of the various women featured in his often bawdy poetry might have been his wife, though the ones who required pay can probably be ruled out. But it is known that when he settled in Italy, he did so under the patronage of a high-powered plutocrat – Lucius Calpurnius Piso, one of the richest Romans of his day, scourge of Cicero and father-in-law to Caesar.

The 18th-century excavators of Herculaneum – they had started off just sinking a well, and then, finding relics at the bottom, began tunneling out belowground – realized fairly quickly that the villa was something special. It was vast, filled with beautiful mosaics and sculptures. Its design, with long colonnades flanking a pool in the courtyard, was so pleasing that when John Paul Getty needed a design on which to model his villa in Malibu, he used what was by then known as the Villa of the Papyri. Clearly, this was the home of someone with serious amounts of money, who was either cultured or at least hoped to appear so. It's hard to imagine that Piso – who had a live-in philosopher on call – would not have had an extensive library.

Why, then, were the uncovered works more or less all by Philodemus? One answer is that these papyruses were in the process of being saved from the disaster when the mud rolled over the villa, the boiling sea lapping at its lower terraces. The papyruses were discovered scattered along the colonnades, some loose, some in packing cases, as though they were in transit. The writings of Philodemus, goes the argument, had a special emotional value to Piso's heirs, because Philodemus had once lived in the villa. So when the volcano erupted, slaves were sent to gather the scrolls and carry them down to the shore, where boats would take them to safety with the rest of the household. The bulk of the library – works by more famous hands, but not as precious to the family and more easily replaced – was abandoned. According to this theory, some buried part of the palace may contain a collection of ancient texts too commonplace to have been worth saving then and too valuable to ignore now.

In the 1990s, new excavations brought the villa into daylight for the first time. In a great pit surrounded by greenhouses, the terraces that once led down to the sea have been revealed. But the rooms set within those terraces remain encased in rock. Many of the archaeologists involved feel this is appropriate; their principal interest is stopping the already excavated part of the town, a few hundred meters from the villa, from deteriorating. But to classical scholars, those hidden rooms are as exciting as unread poems by Dante or unseen plays by Shakespeare.

At present, through careful negotiation and some gentle lobbying of international opinion, the classicists are making progress persuading the preservationists to support further excavation. But even so, plans are limited to feasibility studies.

So whether the books, in fact, lie within, no one can know. The story of Piso's family saving the works of Great-grandfather's friend Philodemus is appealing, but it's hardly the only way things could have happened. Maybe there was no library – perhaps Piso's heirs were uninterested in such pursuits, their villa shelves as bare of reading matter as those of Camp David are said to have been during the presidency of Bush the Elder – and only the works of Philodemus were kept for sentimental reasons. Maybe they were stored separately, while the main library was bulldozed into the sea by the wall of mud.

Or maybe the rest of the library escaped with the villa's owners and slaves as they fled the cataclysm; maybe all was saved *except* for the works of Philodemus. Maybe Piso's heirs were among those who, early on in the eruption, managed to escape by sea, and as they sailed away, their world ablaze, maybe they gave a thought to the works of Philodemus left behind. Maybe they commemorated the loss by intoning the philosopher-poet's own prayer for a safe voyage:

Ino's son Melicertes, and you, Leukothea, grey ruling
Spirit of the sea, protector from evils,
And choruses of Sea-nymphs, and waves, and you, Poseidon,
And Thracian Zephyrus, gentlest of the winds,
Carry me softly across a flat sea as I flee
To land safe at the sweet shore of Peiraeus.

Among all the maybes, though, some certainty: No one on that dreadful day imagined that the scrolls left behind, crushed into the earth by flaming rock, would last longer than Rome's empire, or any empire that followed it. No one dreamed they'd one day be the last of their kind on earth, their words read with light that the eye cannot see, rewritten on discs of melted sand. ■ ■ ■

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